DEC 31 1928

The Engineer.

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VOL. CXLVI.—No. 3805] LONDON: FRIDAY EVENING, DECEMBER 14, 1928 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director-General, India Store Department, Belvedere-road, Lambeth, London, S.E. 1, invit s TENDERS for :—

SCHEDULE 1.—COPPER FIRE-BOX PLATES for LOCOMOTIVES.

SCHEDULE 2.—FORTY-NINE LOCOMOTIVE BOILERS, with Cylinders and Equipment.

SCHEDULE 3.—EIGHT LOCOMOTIVE BOILERS, with Motion Sets.

SCHEDULE 4.—EIGHT GARRETT TYPE LOCOMOTIVES for Metre Gauge.

SCHEDULE 5.—3000-kW TURBO-ALTERNATOR SET, BOILER, SWITCHGEAR, &c.

Tenders due on the 8th January 1929, for No. 1; on the 15th January, 1929, for Nos. 2 and 3; on the 18th January, 1929, for No. 4; and on the 5th February, 1929, for No 5.

Forms of Tender obtainable from the above at a fee (which will not be returned) of 5s. for each Schedule. 466

PROFESSOR OF MECHANICAL ENGINEERING, COLLEGE OF ENGINEERING, GUINDY, MADRAS.

Applications are INVITED for the PROFESSORSHIP of MECHANICAL ENGINEERING at the College of Engineering, Guindy, Madras.

Candidates should not be more than 40 years of age. They must hold an Honours Degree in Mechanical Engineering and have had practical experience.

Salary Rs. 1000 a month, rising by annual increments of Rs. 50 a month to Rs. 1500. An officer of non-Asiatic domicile will draw in addition overseas pay of £25 a month. Total minimum pay for officer of non-Asiatic domicile equivalent to approximately £1200 a year. Appointment on agreement for five years in first instance with possibility of extension. Free first-class passage to India for candidate and family. Strict medical examination.

Further particulars and forms of application may be obtained upon request by postcard to the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, 42, Grosvenor-gardens, London, S.W. 1.

Last date for receipt of applications 31st December, 1928 397

Armstrong College,

NEWCASTLE-UPON-TYNE.

(IN THE UNIVERSITY OF DURHAM.)

COURSES for the PASS DEGREE of B.Sc. and the HONOURS DEGREE of B.Sc. in MECHANICAL, MARINE, CIVIL or ELECTRICAL ENGINEERING, MINING, METALLURGY, or NAVAL ARCHITECTURE. The curricula of the Pass Degree and the Honours Degree normally occupy periods of three and four years respectively, but candidates presenting evidence of sufficient previous training may be allowed to proceed to either Degree after two years' residence.

The engineering laboratories have recently been extended, and all Departments are equipped for advanced tutorial and research work.

Full particulars of the Courses may be had on application to

THE REGISTRAR,
Armstrong College,
223 Newcastle-upon-Tyne.

Madras and Southern Mahratta RAILWAY COMPANY, LIMITED.

REQUIRED for service on the Company's Railway in India, ONE ELECTRICAL ENGINEER and ONE ASSISTANT ELECTRICAL ENGINEER.

ELECTRICAL ENGINEER.

QUALIFICATIONS—

(1) Age not exceeding 36 years. Good general education, preferably a Public School.
(2) Four years' technical course at a University, with a Degree in Electrical Engineering.
(3) Not less than three years' Workshop Training, including Electrical Test and Drawing-office.
(4) Not less than three years' practical experience in Oil and Steam-operated Electric Generating Undertakings, with experience also in the Laying, Erection and Maintenance of Electric Cables and Aerial Lines, the Maintenance of Transformers and Switchgear, and the Maintenance of Distribution Networks.
(5) Experience with a firm of contracting engineers or manufacturing works undertaking complete Electric Generating and Sub-station Equipment.
(6) Experience with a firm of Consulting Engineers.

SALARY.—At age of 36 years, Rs. 975 basic pay, plus £30 overseas pay per mensem.

ASSISTANT ELECTRICAL ENGINEER.

QUALIFICATIONS—

(1) Age about 25 years. Good general education, preferably a Public School.
(2) Thorough knowledge of Telegraph and Telephone Work as applied to Railway Working.
(3) Experience in Lock and Block Track Circuiting, Token Instruments, Automatic and Manual Telephone Exchange and Control Circuits, Wheatstone and Duplex Telegraphs.
(4) Experience of Line Construction and Maintenance and Laying of Telegraph Cables.

SALARY.—According to age and experience, ranging from Rs. 375 basic pay, plus Rs. 150 overseas pay per mensem, to Rs. 475 basic pay, plus Rs. 150 overseas pay per mensem.

TERMS APPLICABLE TO BOTH APPOINTMENTS.

Subject to a strict medical examination by the Company's Consulting Physician, a three years' agreement in the first instance, a first-class free passage to India and home again on satisfactory termination of agreement, which is extensible by mutual consent. Employees are required to subscribe one month's pay yearly to the Company's Provident Fund, and to those of over 5 years' service, a bonus equal to their contribution is credited, both bonus and contribution accumulating at compound interest until retirement.

Applications, by letter only, giving full particulars of general and technical education and practical experience in chronological order, stating age, honours gained (if any), whether married or single, together with COPIES only of testimonials, must be addressed as below not later than Tuesday, 8th January, 1929.

THE SECRETARY,
Madras and Southern Mahratta Railway Co., Ltd.,
25, Buckingham Palace-road,
Westminster, S.W. 1.
12th December, 1928. 456

The Engineer

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PUBLIC NOTICES

Great Western Railway.

The Directors of the Great Western Railway Company have FOR DISPOSAL GAS ENGINES and DYNAMOS, which can be seen in commission at Swindon.

Applications to view should be made to Mr. A. C. Cookson, the Company's Stores Superintendent at Swindon, Wilts., from whom full particulars may be obtained.

F. R. E. DAVIS, Secy.
Paddington Station, London, W. 2. 424

The Assam-Bengal Railway COMPANY, Limited, is prepared to receive TENDERS for :—

BODY IRONWORK AND FITTINGS FOR BOGIE CARRIAGES.

Specifications and Tender forms may be obtained at the offices of the Company, Bishopsgate House, 80, Bishopsgate, E.C. 2. A fee of £1 1s. is charged for each specification, which cannot under any circumstances be returned.

Drawings may be had at the cost of the tenderer by application to Messrs. Hodges, Bennett and Co., Ltd., 78, Queen Victoria street, E.C. 4.

Tenders must be delivered at the Company's offices not later than Noon on Wednesday, the 2nd January, 1929.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board.
THOS. C. BRETT.
Secretary.
10th December, 1928. 457

The Madras and Southern MAHRATTA RAILWAY COMPANY, Limited, invite TENDERS for—

METALS (comprising ALUMINIUM Ingots and Sheets, ANTIMONY, BRASS Rods, Sheets, Tubing and Wire, COPPER Gauze, Ingots, Rods, Sheets, Tubes and Wire, LEAD Piping, Sheeting, Phosphor Copper and Bronze, ZINC Sheets and Ingots).

TENDERS are due in on Tuesday, 1st January, 1929, by 2.00 p.m.

Tender form obtainable at address below, fee ONE GUINEA, which is not returnable.

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices—
25, Buckingham Palace-road,
Westminster, S.W. 1. 457

PUBLIC NOTICES

The Salisbury Electric Light AND SUPPLY COMPANY, LIMITED.

The above Company has the following PLANT FOR DISPOSAL :—

ONE 95 horse-power Electric Lighting type Crossley GAS ENGINE, with Compressor and Sundries.
SUCTION GAS PLANT and Accessories, to suit above engine.
DYNAMO, 550 volts, 91 amps.
MOTOR GENERATOR, 500 volts, 100 amps., to 100/160 volts, 250 amps.
SWITCHBOARDS and SUNDRIES.

All plant modern make and in very good condition. Can be seen by appointment if desired.

Communications and offers to be addressed to the MANAGER, 27, Market-place, Salisbury. 452

Administrative County of LONDON.

REBUILDING OF LAMBETH BRIDGE.
APPOINTMENT OF A RESIDENT ENGINEER.

The London County Council invites APPLICATIONS for the POSITION of RESIDENT ENGINEER in connection with the rebuilding of Lambeth Bridge over the River Thames between Westminster and Lambeth.

The appointment will be upon the temporary staff; selected candidate will be appointed by and serve under the direction of the Council's Chief Engineer.

The salary will not exceed £800 a year inclusive.

Candidates must be Corporate Members of the Institution of Civil Engineers. Practical experience with an engineer or contractor in control of works of bridge construction or other works of a similar character, involving the sinking of caissons under compressed air, is essential, and candidates must be physically fit to the satisfaction of the Council's Medical Examiner for compressed air work.

Forms of application may be obtained either by personal call at the County Hall (Room 216) or by sending a stamped addressed foolscap envelope, marked "Resident Engineer, Lambeth Bridge," to the Clerk of the Council, The County Hall, Westminster Bridge, S.E.1. The latest time for receiving applications is Monday, 17th December, 1928. Canvassing disqualifies.

MONTAGU H. COX,
332 Clerk of the London County Council.

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED

PRODUCTION ENGINEER.—APPLICANTS for the SITUATION advertised November 16th (Box 189) are THANKED and informed that the POSITION has now been FILLED. 426 A

SITUATIONS OPEN (continued)

WANTED, ENGINEER, for Oilfield in the Punjab. Good general practical mechanical training and electrical experience.
Drawing-office experience a recommendation.
Age 22/26. Unmarried.
First agreement 3 years.
Salary, excluding allowances, but including Provident Fund, Rupees 3900, Rs. 4550, and Rs. 5200 per annum.
Passage paid, medical expenses and furnished quarters free.
Write, giving age, full particulars of experience and copies of testimonials, to Z.B. 201, c/o Deacon's Advertising Agency, Fenchurch-avenue, London. 449 A

WANTED, First-class ENGINEER, to Take Charge of and Manage a large new modern Pressed Brickworks near London and be fully responsible for output, cost of production, and general works organisation. Previous experience essential. Good salary and bonus on profits paid to the right man.—Address, P5288, The Engineer Office. P5288 A

WANTED for a Firm of English Structural Engineers in India, an OFFICE MANAGER and CHIEF DESIGNER. Knowledge of Bridge Work essential and must have had both works and administrative experience. Age about 35. Commencing remuneration the equivalent of £2000 per annum, with excellent prospects.—Write, with full particulars of career and, if possible, a photograph, to Z.C. 206, c/o Deacon's Advertising Agency, Fenchurch-avenue, London. All applications will be treated as strictly confidential. 460 A

WANTED for a British Engineering Firm with First-class Home agencies in Calcutta, an ASSISTANT with Mechanical Engineering Training. Age between 24 and 28. Unmarried. Commencing salary with annual increases the equivalent of £450 to £500, according to qualifications.—Reply in writing, with copies of testimonials and, if possible, a photograph, to Z.C. 202, c/o Deacon's Advertising Agency, Fenchurch-avenue, E.C. 3. 450 A

WANTED for London Office, CHIEF ENGINEER, for estimating, manufacture and general supervision of contracts for Oil Refining Plant and Steam Auxiliaries.—Address, P5296, The Engineer Office, stating qualifications and salary required.
APPLICATIONS for the POSITION of CHIEF DRAUGHTSMAN will also be considered. P5296 A

CEMENT WORKS ASSISTANT ENGINEER WANTED at short notice for Far East; must have sound engineering training and experience of running Cement-making Machinery, and pass medical examination; three years' agreement; first-class passage out and home; salary £500 per annum and free unfurnished quarters, or allowance in lieu thereof. Only those with above qualifications need apply.—Write, Z.M. 190, care of Deacon's Advertising Agency, Fenchurch-avenue, E.C. 3. 468 A

COMMERCIAL ENGINEER AND SALES MANAGER.—WANTED for a Factory in the South of England, SALES MANAGER, having extensive knowledge of engineering workshop practice and procedure, together with experience on the sales side. Knowledge of sales methods in colonial and foreign markets is essential, and no applicant will be successful unless he can show that he has an established connection both at home and abroad.—Address, with a statement of experience and copies of any testimonials, P5275, The Engineer Office. P5275 A

ELECTRICAL ENGINEER, with Sound Knowledge and experience of Electrical Equipment at Collieries, including H.T. and L.T., A.C. and D.C. Generation, Transmission and Distribution.—Reply by letter, giving full particulars experience, age, and salary required, to PEARSON and DORMAN LONG, Limited, Engineer's Office, Richborough, Kent. 448 A

ENGINEER REQUIRED AT ONCE in London District. Must be a good Electrical and Mechanical Engineer, to be responsible for the Electrical Plant Maintenance and Repair of General Production Plant throughout the factory, also Maintenance of and Additions to Buildings.—Address, stating age, full details of experience (in date order, giving names of employers and positions filled), and salary required, 432, The Engineer Office. 432 A

PHOTO BLUE PRINTING.—MAN WANTED, to Take Charge of Manufacturing Engineers' Blue Printing Room and Drawing Files. Knowledge of Hall's Rotary Photo Copiers and modern Blue Printing, Photostat, and Reproduction Processes essential, together with experience of routine filing and card indexing.—Address, stating age, experience, and salary required, 377, The Engineer Office. 377 A

REINFORCED CONCRETE. — REQUIRED for Durban, REINFORCED CONCRETE ENGINEER, with good experience in design, estimating and preparation of working drawings; good personality and experience with specialist firm essential.—Address, stating age, qualifications, when available, and salary required, P5292, The Engineer Office. P5292 A

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SITUATIONS OPEN (continued)

REQUIRED, a SURVEYOR, with Considerable experience, capable of Taking Charge of a Survey in South America, involving triangulation, traversing, levelling, computations and detail work on large and medium scales.—Write, stating qualifications, age, and salary required, to Box No. 60, c/o White's, 72-78, Fleet-street, E.C. 4. 423 A

REQUIRED by Firm of Gearing Specialists Having headquarters in London, YOUNG ENGINEER-SALESMAN, to travel throughout the country. Previous travelling experience a recommendation.—Write, giving full details as to age, experience, education, and salary required, to Box 87, c/o Mather and Crowther, Ltd., 10/13, New Bridge-street, London, E.C. 4. 467 A

RESPONSIBLE POSITION in Sales Dept. is OPEN to right man with initiative, technical training and experience in all classes of Batteries. Must have unimpeachable references.—Address, 443, The Engineer Office. 443 A

SUPERVISING ENGINEER WANTED, to Take Charge of Plant and Maintenance Work.—Reply, stating full particulars as to experience and salary desired, to the SECRETARY, The Clyde Alloy Steel Co., Ltd., Craigneuk Works, Motherwell. 447 A

WANTED by Crane Firm in Midlands, DRAUGHTSMAN, to Take Charge of Small Drawing-office; must be capable in all branches of Jib Crane Design. Permanency for suitable man. State age, experience, and wages required.—Address, 446, The Engineer Office. 446 A

WANTED, DRAUGHTSMEN, Age 21-25, with First-class technical and shop training. Experience in the design and lay-out of Centrifugal Pumps essential.—Address, stating full particulars, 462, The Engineer Office. 462 A

WANTED, First-class CARRIAGE and WAGON DRAUGHTSMEN; experienced men only.—Apply, giving particulars of experience, salary required, &c., to THE BIRMINGHAM RAILWAY CARRIAGE and WAGON CO., Ltd., Smethwick. 453 A

WANTED, DRAUGHTSMAN, with Experience of Power Station Details, Steel Work, Foundations, Piping, &c. Some electrical experience desirable. London area. Applicants must state experience, age, and salary required.—Address, P5281, The Engineer Office. P5281 A

WANTED IMMEDIATELY, Temporary, SEVERAL first-class DETAIL DRAUGHTSMEN, preferably with experience of High-speed Oil or Petrol Engine Work.—Write, stating full details of experience, age, and salary required.—Address, "DRAUGHTSMAN," Wm. Porteous and Co., Glasgow. P5280 A

CHIEF DRAUGHTSMAN (LOCOMOTIVE).—Applications, in writing, will be considered till 15th December, 1928, for fully qualified Engineer. Must have held a similar position in the drawing-office of a locomotive engineering firm of good standing.—State previous experience and remuneration expected, enclosing testimonials (copies only), to NORTH BRITISH LOCOMOTIVE COMPANY, Limited, 110, Flemington-street, Glasgow. P5240 A

CHIEF TOOL DESIGNER, to Take Charge of Tool Drawing-office. Responsible position for man of experience and proved ability. Knowledge of latest methods of production, lay-outs and time study essential. Experience of Automobile Electrical Equipment preferred. State age, salary required, &c.—Address, 444, The Engineer Office. 444 A

DRAUGHTSMAN, Experienced in the Design and construction of Conveyor Mechanism, REQUIRED AT ONCE, to Take Charge of New Department.—Address, stating experience and salary required, 433, The Engineer Office. 433 A

DRAUGHTSMAN REQUIRED by Electrical Manufacturer; must be experienced in the design and lay-out of Works Plant. Give particulars of experience, state age and salary required.—Address, 451, The Engineer Office. 451 A

DRAUGHTSMAN REQUIRED by Midland Firm of Constructional Engineers. Must be fully qualified to design and estimate for Steel-framed Buildings, Lattice Girders, Towers, &c.—Address, with full particulars and salary required, 372, The Engineer Office. 372 A

DRAUGHTSMAN REQUIRED (Designer and Estimator) for Light Steel Roofs and Buildings. State age and salary required and past experience in confidence. Permanency for the right man.—Address, P5283, The Engineer Office. P5283 A

DRAUGHTSMEN REQUIRED, 25-30 Years of Age, for I.C. Engines, Road Rollers, Roadmaking Machinery, and Commercial Vehicles. State age, experience, salary required, and when free.—Address, 438, The Engineer Office. 438 A

DRAUGHTSMAN, SENIOR, with First-class Experience of Steam Turbine Design and Details.—Apply, stating age, experience, and salary required, to MANAGER, Drawing-offices, B.T.H. Co., Ltd., Rugby. 427 A

DRAUGHTSMAN WANTED by Firm Manufacturing all classes of Pumping Machinery. Experience of Centrifugal and Turbine Pumps an advantage. Age 30-35.—Address, stating age, experience, and salary required, 464, The Engineer Office. 464 A

DRAUGHTSMEN WANTED for Tool and Jig Design in large Electrical Engineering Works located in the South Midlands.—Address, giving full details of training, firms worked for, age, &c., 428, The Engineer Office. 428 A

DRAUGHTSMAN WANTED IMMEDIATELY Near London, age 25 to 30, with practical shop knowledge general engineering and accustomed design Steel Plate Work (heavy and light). State salary.—Address, P5289, The Engineer Office. P5289 A

ENGINEER and ESTIMATING DRAUGHTSMAN with Intimate knowledge of Chemical Process Plant, including Evaporating and Distilling Equipment, REQUIRED by Engineers, Glasgow. State full particulars and experience.—Address, 312, The Engineer Office. 312 A

EXPERIENCED DRAUGHTSMAN REQUIRED for Engineer's Office, India.—Write, stating age, qualifications, CARRIER ENGINEERING COMPANY, Limited, 24, Buckingham-gate, S.W. 465 A

JUNIOR DRAUGHTSMAN (Mechanical) WANTED. Salary 40s. per week plus cost-of-living bonus (total salary with current bonus 64s. 3d.).—Write to COMMANDANT, Experimental Station, Porton, near Salisbury. 463 A

LEADING DRAUGHTSMEN REQUIRED for London Constructional Engineers' Drawing-office. Previous experience in similar work essential. State age, slary required, and full particulars of experience. Permanent positions for suitable applicants.—Address, 445, The Engineer Office. 445 A

REQUIRED AT ONCE, SENIOR CRANE DRAUGHTSMAN, Birmingham district.—Address, 359, The Engineer Office. 359 A

SITUATIONS OPEN (continued)

REQUIRED, First-class JIG and TOOL DRAUGHTSMAN; preference given to man with experience of designing rolls and dies for producing sections of light-gauge strip. State age, experience, salary, when at liberty, &c., to Messrs. THE BLACKBURN AEROPLANE and MOTOR CO., Ltd., Brough, E. Yorks. 398 A

SENIOR DRAUGHTSMAN and DESIGNER WANTED, with good experience in the design of the latest type Commercial Vehicles.—Address, giving full particulars of experience, age, and salary required, 376, The Engineer Office. 376 A

SENIOR DRAUGHTSMAN, Instrument Design Experience preferable. Good prospects. London district.—Box 4358, Woodwright Service, Ltd., 150, New Bond-street, W. 1. 375 A

STRUCTURAL STEEL WORK DRAUGHTSMAN (Temporary) REQUIRED in Railway Office. Must be capable of measuring up on site and making calculations of existing bridges.—Address, 442, The Engineer Office. 442 A

TWO SENIOR DRAUGHTSMEN REQUIRED: One Heating and One Ventilating. Both must be capable of handling enquiries and contracts in their entirety and to take charge of their departments as and when necessary.—Address, 458, The Engineer Office. 458 A

SITUATIONS WANTED

A FULLY QUALIFIED ENGINEER and DESIGNER of proved inventive ability OFFERS his SERVICES (part or whole time). Wide and varied experience, competent to develop schemes, &c. Used to intricate machinery. Highly successful record. First-class diplomas, &c. Fluent French.—Address, P5297, The Engineer Office. P5297 B

ASSOC. M. INST. C.E. (29), Roads, Public Works, reinforced concrete, experienced control of labour, completed 5 years' contract, AT LIBERTY IMMEDIATELY.—Address, P5276, The Engineer Office. P5276 B

ENGINEER (31), Alert and of Good Address, with wide experience in modern works and erection, at present chief erector and representative on important contracts, DESIRES CHANGE, home or abroad.—Address, P5295, The Engineer Office. P5295 B

MARINE ENGINEER, Aged 31, REQUIRES BERTH ashore; 1st Class B.O.T. Cert., 9 years' steam experience, 1 year chief.—Address, P5279, The Engineer Office. P5279 B

MACHINE TOOL SALESMAN, with Connection in Lancashire and Yorkshire, DESIRES POSITION with Machine Toolmaker; fourteen years' travelling experience.—Address, P5277, The Engineer Office. P5277 B

M/C. SHOP FOREMAN SEEKS SIT. in Midlands. At present controlling millers, planers, and slotters on medium ordnance work. Age 34. Sal. req. £6.—Address, P5278, The Engineer Office. P5278 B

WORKS MANAGER, Disengaged, SEEKS POST. Boiler shops, structural and general engineering; 10 years' managing experience, expert on welding products, electric and acetylene, homogeneous lead burning experience. Good references.—Address, P5293, The Engineer Office. P5293 B

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For full particulars and advice apply to:—6-11, TRAFFORD CHAMBERS, 58, SOUTH JOHN ST., LIVERPOOL (Tel. Bank 1118). LONDON OFFICE:—65, CHANCERY LANE, W.C. 2. EX.

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BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY,
22, Shakespeare House, Leicester-square, London.

SURVEYING AND LEVELLING.—IMMEDIATE VACANCY for a PUPIL; thorough instruction given.—Address, E. MOUL, Hollybank, Woking. P5202 B

MISCELLANEOUS

BOILER SCALE.—INVENTORS of Process for the Prevention of Scale in Boilers WISH a TRIAL to be made, at their own expense, on a BOILER where the water is highly mineralised and scale gives the maximum trouble.—Apply, BASINGHALL SYNDICATE, Ltd., 6A, Tudor-street, London, E.C. 4. 439 I

FIRM WISHES to GET in TOUCH with SMALL ENGINEERING WORKS in or near London with up-to-date Plant to Machine and Erect various Machines of a heavy type.—Address, 469, The Engineer Office. 469 I

M.I. STRUCT. E., A.M.I. MECH. E., Having Wide and varied experience, will UNDERTAKE the INSPECTION and TESTING of all classes of MACHINERY. Enquiries invited for second-hand machinery.—ENGINEER, 67, Lord-street, Liverpool. P5241 I

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A.—Power-house Attendant: £100 a year increase in 12 months.
B.—Engineer at Sea: Secured a shore job of £400 p.a. within 6 months.
C.—Loco. Engineer: In 6 months secured a £14 per week job.
WHATEVER YOUR POSITION, T.I.G.B. Postal Training will profit you. Moderate fees. Easy instalments. Free text-books. Employment facilities. Specialised coaching for A.M.I. Mech. E., A.M.I.E.E., etc., etc. Write NOW for the 64-page book, "The Engineer's Guide to Success," Free and Post Free.
THE TECHNOLOGICAL INSTITUTE OF GREAT BRITAIN (*Established* 1917),
76, Temple Bar House, London, E.C. 4.

AGENCIES

A.M. INST. C.E., Public School, 40, with Extensive mechanical, electrical and commercial engineering experience, wide connection amongst manufacturers and contractors, DESIRES to CONNECT with FIRMS who REQUIRE Technical and adequate REPRESENTATION, Yorkshire and Lancashire, Leeds or Bradford centre. Highest references. Commission basis.—Address, P5265, The Engineer Office. P5265 D

ENGINEER, with Practical Experience and Established connection in Lancashire, office Manchester, WISHES to REPRESENT sound ENGINEERING FIRM.—Address, P5286, The Engineer Office. P5286 D

PROVINCIAL ENGINEERING WORKS WISH to APPOINT SOLE SELLING AGENTS for their Horizontal Petrol Engines in the British, Colonial and foreign markets.—Address, P5294, The Engineer Office. P5294 D

THE WATER METER COMPANY, 34, Fenchurch-street, London, E.C. 3, are prepared to APPOINT AGENTS in various districts for the SALE of the ASTER POSITIVE WATER METER. Firms and representatives calling on water companies are invited to apply for particulars to Ref. E. 9858 D

WITTY and WYATT, Ltd., 28, Commercial-st., E. 1, Engineers, Mill and Factory Furnishers, REQUIRE REPRESENTATIVES fully acquainted with the requirements of above trades. Exceptional terms to those with good connection. Write, stating full particulars. 321 D

PATENTS

IT is DESIRED to SECURE the Full COMMERCIAL DEVELOPMENT in the United Kingdom of BRITISH PATENT No. 233,125, which relates to "Brake, Clutch and like Linings," either by way of SALE or the GRANT of LICENCES on reasonable terms.—For particulars apply, PHILLIPS'S, 70, Chancery-lane, London, W.C. 2. 429 H

IT is DESIRED to SECURE the Full COMMERCIAL DEVELOPMENT in the United Kingdom of BRITISH PATENT No. 242,341, which relates to "Rotary Valves for Internal Combustion Engines," either by way of SALE or the GRANT of LICENCES on reasonable terms.—For particulars apply, PHILLIPS'S, 70, Chancery-lane, London, W.C. 2. 430 H

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A Seven-Day Journal

The Piccadilly Underground Station.

THE new station for the Underground Railways at Piccadilly Circus, work upon which was begun in February, 1925, was officially opened by the Mayor of Westminster on Monday morning last, and on the afternoon of the same day it was made available for passenger use. An illustrated description of the scheme will be found in our issues of April 29th and May 6th, 1927, while on July 13th this year we reviewed the progress made up to that date. The new station is designed to deal with passengers at the rate of 50,000,000 per year, and at the present time it is being worked at about half that rate. The new booking hall, which is 15ft. below the roadway and is entered by seven short subways, is pleasingly decorated and lighted, and considerable wall space has been set apart for shop window display. The automatic booking machines and passimeter booths are grouped at the entrance to the two main tunnels, having three and two escalators respectively, and connecting the booking hall with the common landing some 57ft. below it. From this point two further tunnels, each with three escalators, serve the platforms of the Bakerloo and the Piccadilly railways. The estimated cost of the whole work is given as half a million pounds. The opening ceremony was presided over by Lord Ashfield, the chairman of the Underground Railway Group, who referred in his speech to the necessity for further extensions of the underground railways in a northward direction and also westward beyond Hammersmith. These extensions, he said, would undoubtedly come if some kind of co-operation and goodwill was established among the various authorities dealing with London's passenger traffic. He regarded the new station as not only the best in London, but the best in the world, and paid tribute to the way in which the work had been carried through by all concerned, without a single serious accident.

The Late Mr. David Gibson.

QUITE a shadow was cast over the happy arrangements made by R. and H. Green and Silley Weir, Ltd., for the large party which visited Falmouth on Friday last to inspect the pulverised fuel equipment on the New Zealand steamer "Hororata," when it became known that one of the party, Mr. David Gibson, the superintendent of the L.M. and S. marine engineering department at Euston, had been found dead in his sleeping berth on the arrival of the train at Paddington on Saturday morning. With his unrivalled knowledge of marine engineering problems, he had the day before taken the greatest interest in the installation described elsewhere in to-day's issue. Before joining the L.M.S. Railway in 1900, Mr. Gibson, who was only fifty-six years of age at the time of his death, had spent some years in the service of the Bibby Line and of Messrs. Denny at Dumbarton. His first railway duty was to take charge of the hydraulic department of the Lancashire and Yorkshire Railway Company under Mr. George Hughes, with his headquarters at Horwich. The supply of water to the railway was a difficult problem, and Mr. Gibson also had under his charge the whole of the hydraulic machinery used in docks and harbours, in goods yards and other depôts. He was also responsible for the preparation of specifications and drawings and the maintenance of the cross-Channel railway boats between Fleetwood and Belfast, Liverpool and Drogheda, and Goole and the Continent. For a short time before his appointment to Euston, Mr. Gibson was works manager at Horwich, and showed great skill both in production and in the handling of men. He was a great reader, and gave considerable assistance to the Horwich Literary Society and the Horwich Mechanics' Institute. His loss will be keenly felt, alike in railway, shipping, and shipbuilding circles.

Cheaper Electricity.

FROM January 1st, 1929, the County of London Electric Supply Company, Ltd., proposes to introduce two-part tariffs for domestic and business consumers of electricity in its area of supply, which covers over 200 square miles. The charge per unit for electricity for all purposes, *i.e.*, lighting, heating, cooking, and for domestic and business appliances, will be 1d. per unit, and this charge will be accompanied by a fixed quarterly charge. In the case of private houses the fixed charge will depend upon the dimensions of the house to be supplied, and in the case of shops and business premises it will be based upon the wattage of the lighting installation. Consumers are to have the option of adopting the new tariffs as an alternative to the present flat rates charged by the company. In the case of houses up to 1000 square feet floor area the quarterly fixed charge will be 12s. 6d. There will be no meter rent, and for every unit consumed, for whatever purpose, the charge will be 1d. Larger premises are to be grouped according to the square foot area, and increases are to be made in the quarterly fixed charge, but the running charge of 1d. per unit will be uniform. For an average four-bedroom house in which electricity is used for cleaning, heating and cooking, as well as for lighting, there will, it is estimated, be a resultant overall price per unit of about 1¼d. during the year. For shopkeepers and business premises the fixed quarterly charge will be assessed on a different basis owing to the disparity between one establishment and another in the use of electricity. The trader will pay his fixed charge on the basis of the wattage of the lights he employs, and for every unit he consumes for all purposes he will pay the uniform rate of 1d.

Turbo-Generator Sets for the London Power Company.

WE hear with much pleasure that the board of the London Power Company has placed orders for two 67,250-kW turbo-alternators. One of the sets has been ordered from the British Thomson-Houston Company, of Rugby, and the other from the Metropolitan-Vickers Electrical Company, of Manchester. They are to be designed for a pressure of 570 lb. per square inch and a total temperature of 850 deg. Fah. The three-phase 50-cycle alternators will be wound for a pressure of 11,000 volts, and they will run at a speed of 1500 revolutions per minute. The sets are the largest that have so far been ordered in Great Britain.

Mechanical Transport in the Empire Overseas.

IT is officially announced that the Secretary of State for Dominion Affairs and for the Colonies—Mr. L. S. Amery—has appointed a "directing committee" to study every aspect of mechanical transport likely to further the economic development of the Empire overseas. Sir James Currie is to be chairman of the committee and the other members will be Sir Henry Fowler, Brigadier-General F. D. Hammond, and Mr. Herbert Niblett, with Mr. J. C. May, 2, Wood-street, Westminster, S.W. 1, as secretary. One of the primary objects of the committee, it is stated, will be the development of a large mechanical transport unit which will not be confined to operating on good roads. As soon as the progress of the work is sufficiently advanced experiments will be carried out in selected areas overseas. It is anticipated that the expenses of the committee will be shared as to one-half by the Empire Marketing Board and as to the other half by the various overseas Governments which will take part in the work. In order, however, to enable an immediate start to be made with the work, the Empire Marketing Board is advancing the whole amount required for the first year. A considerable amount of work on the subject has already been done in Australia. In Africa the development of the tropical Colonies is particularly closely bound up with a solution of the mechanical transport problem. It is proposed ultimately to set up an Oversea Mechanical Transport Committee comprising representatives of the Home and Colonial Governments and of such of the Dominion Governments as may desire to co-operate in the work. The Directing Committee has been appointed in order that the investigation of the urgent question of mechanical transport overseas may be begun promptly.

The Ironbridge Power Station.

FOR the construction of the Ironbridge electric generating station, a new capital station associated with the Central England electricity scheme, the Electricity Commissioners have authorised the West Midland Joint Electricity Authority to borrow £700,000 on account of the estimated cost of £960,000 for the first section of the station. The ultimate capacity of the complete station will be 200,000 kW, and there will be four 50,000-kW sets. The first section of the station will be completed towards the end of 1930. Instead of providing for the West Midlands alone, as originally planned, the Ironbridge station will become one of the principal base load stations for Central England. Under the Central England electricity scheme it is proposed to use nineteen of the forty-six generating stations in operation or authorised in the area as well as the new station at Ironbridge. Five more stations, at Birmingham, Kettering, Coventry, Loughborough and Stafford, may also be operated for the Central Board during the transitional period under a temporary arrangement clause.

Amalgamations in the German Locomotive Building Industry.

FOR some time past there has been a marked tendency towards grouping between the original locomotive firms in Germany and other firms which since the war have entered the locomotive manufacturing business. It is now announced that the Berlin-Tegel firm A. Borsig G.m.b.H has acquired the locomotive business of F. Schichau, of Elbing, and that the complement of German State Railway orders allotted to the Schichau works will be completed along with the firm's private orders at the Borsig works. Efforts are being made by Messrs. Krupps to take over the locomotive manufacturing business of the Linke-Hofmann Lauchhammer A.G., and there has been an amalgamation between the two old-established firms of Henschel and Sohn, of Cassel, and J. A. Maffei, of Munich, which firms, it is understood, are now seeking to co-operate with the Lokomotivfabrik Krauss and Co., also of Munich. Other probable groupings are said to include the Hannoverische Maschinenbau A.G., of Hannover, and the Sächische Maschinenfabrik, of Chemnitz. Further particulars with regard to these amalgamations are expected after the annual general meetings of the companies have taken place. Meanwhile there is a general movement in the direction of re-grouping, so that the quota of several of the smaller locomotive building concerns will be taken over by the larger undertakings.

Next Year's Schneider Trophy Race.

IT is understood that the Racing Committee of the Royal Aero Club has recently decided to hold next year's Schneider Trophy seaplane race over the Solent. Various possible places have been carefully inspected and considered, but it is gathered that in the Committee's opinion the Solent provides the only place which affords the necessary shed and slipway accommodation and a stretch of water sufficient for the operations of aircraft, the speed of which may be expected to reach 300 miles an hour or over. It is probable that five nations will compete in next year's race and that this country will have to defend the trophy which it won at Venice in September last year against teams or machines from France, Italy, America, and Germany. Last year, it may be recalled, the only participants in the race were Great Britain and Italy.

An Indian Irrigation Undertaking.

ON Tuesday last, December 11th, the important Sarda River Irrigation Scheme was formally put into service by Sir Malcolm Hailey, the Governor of the United Provinces of Northern India. The River Sarda rises in the Himalayas nearly due north of Lucknow, and flows in a south-easterly direction. Its name is changed to Chauka some distance before it joins the River Gogra, which, in turn, makes confluence with the Ganges near Chapra. The Irrigation Scheme has involved the construction of a barrage at Banbassa, just where the hills begin to rise from the plains. This barrage has thirty-four openings, each 50ft. wide, which are controlled by steel gates. The river is subject to wide variations in flow, floods of over half a million cusecs having been experienced, while the natural discharge may fall to less than one-hundredth of that volume. The barrage will command an area of upwards of 7,000,000 acres, nearly a fifth of which will, it is anticipated, be brought under cultivation in dry years. The main canal taking off from the barrage is 350ft. wide at the bottom at the start and its depth is just over 8ft. It is 27 miles long. The head works comprise sixteen openings, each 20ft. wide and each controlled by a steel gate. Altogether, some 4000 miles of main and subsidiary canals and distributors are included in the undertaking, the cost of which amounts to something like £7,500,000. Almost simultaneously with the formal proceedings in India, the *London Gazette* published the announcement that in recognition of his outstanding services as superintendent engineer and subsequently as chief engineer in charge of the Sarda Canal Irrigation Works, Mr. Bernard d'Olier Darley was to have the honour of knighthood conferred upon him. Mr. Darley was born in 1880, and is the son of Mr. J. H. Darley, of Dublin. He was educated at Trinity College, Dublin, and Cooper's Hill Royal Engineering College. From 1909 to 1919 he served as an assistant engineer in the United Provinces, and was responsible for the survey design and building of the Mirzapur Canal System. Since 1919 he has been chief engineer of the Sarda Canal Irrigation Works.

The Grounding of the Celtic.

IN the early hours of Monday morning last, December 10th, as she was entering Cork Harbour, the White Star liner "Celtic" ran aground on the Cow and Calf rocks, 150 yards west of Roches Point. The passengers, numbering close on 250, and including 25 members of the crew of the "Vestris," were later landed at Queenstown. Tugs were in immediate attendance, but so far all efforts to float the ship have proved to be unavailing. She has a list of 10 deg. to port, and as her machinery spaces are flooded to a depth of 25ft. at high tide, special arrangements are being made to mount temporary boilers on the deck, so that the ship's winches can be employed to assist in unloading her cargo. The cargo holds, with the exception of No. 3 hold, appear to be dry, and efforts are being made to transfer the cargo of maize, grain and fruit to coasting vessels alongside. If this is done there appears to be a possibility of refloating the ship if bad weather does not intervene. As she lies the "Celtic" is exposed to the seas, and is only accessible on one side. It is thought that her hull has been pierced by the rocks in the way of the engine-room and boiler spaces, and, if so, it will be necessary to float the ship before she can be towed away for repairs. The "Celtic" was built in 1901 by Harland and Wolff, Ltd., and she has a gross tonnage of about 21,026 and a designed speed of 17 knots. During the war she did good service as a troopship, and was twice torpedoed.

The Turbines at the Klingenberg Power Station.

No. II. (*Conclusion*).*

As has been already mentioned, the rotor of each cylinder is separate and runs in its own two bearings. The adjacent bearings of each line of the turbine, and the thrust block which is between them are carried in the same pedestal, and a similar common pedestal serves for the two bearings between the intermediate-pressure cylinder and the generator. The arrangement is somewhat different in the case of the bearings between the low-pressure turbine and its generator, because the low-pressure turbine bearing is carried

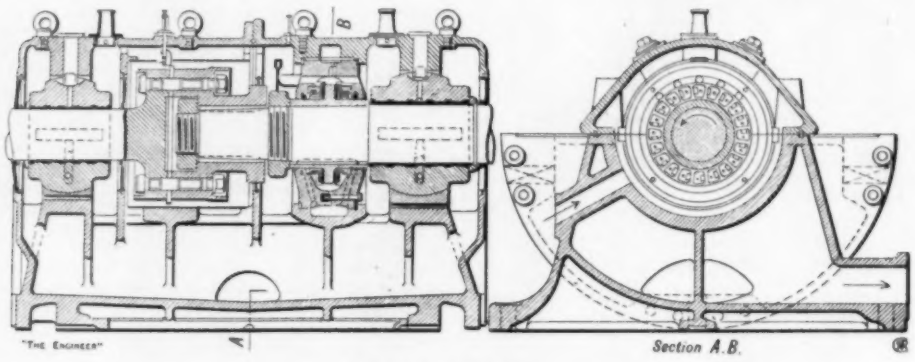


FIG. 11—THRUST BLOCK

from the lower part of the exhaust casing, as is shown in Fig. 7 *ante*. All bearings are lined with white metal, and held in spherical seatings to permit a slight adjustment of the shafts. The thrust bearings are double-faced, single-ring bearings with pivoted pressure pads. The pads are of bronze and work against faces of white metal. In order to safeguard the turbine blading against damage caused by axial displacement of the rotor, through undue wear of the thrust block or otherwise, a special safety device is fitted. It consists of a circular metal plate gripped between the faces of the flanged coupling. It is slightly larger in diameter than the flanges, and the projecting portion runs between a pair of electric contacts on each side. A slight displacement of the rotor is

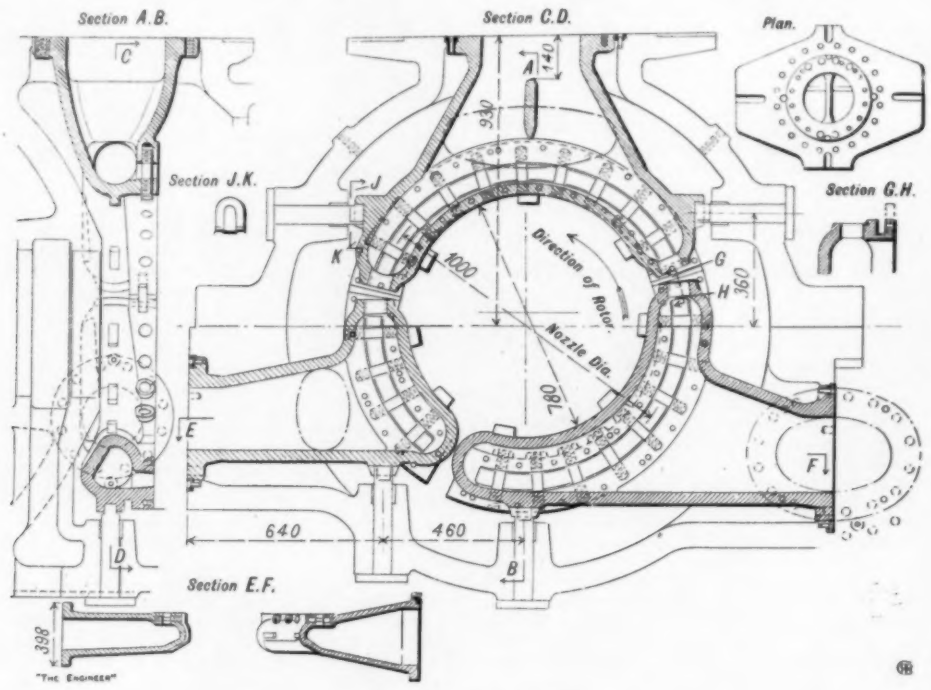


FIG. 12—NOZZLE BOXES

sufficient to short-circuit one or other of the pairs of contacts, with the result that an alarm bell rings. In addition to this device a mechanical indicator is provided, which enables the axial clearance of the rotor to be observed at any time when the machine is running. The arrangement of bearings, coupling and thrust block between the high-pressure and intermediate-pressure turbines is illustrated in Fig. 11.

Since the two generators are connected together electrically, the whole unit can be governed by the regulation of steam to the high-pressure cylinder. The cylinders are so proportioned that, at normal load and with normal steam conditions, the output of the high-pressure and intermediate-pressure cylinders together is just equal to that of the two low-pressure cylinders, so that equal power is developed on each shaft. The governing arrangements were designed with great care, as also were the safety devices, in view of the enormous power of the unit. Steam enters the turbine through three nozzle boxes—as shown in Fig. 12—which together make up the full circumference of the first turbine wheel. The admission to each nozzle-box is controlled by a cam-operated valve actuated by the governor, as illustrated in Fig. 13. For all loads up to half load, one nozzle group only is in action, two nozzle groups suffice for loads up to three-quarter load, while from three-quarter to full load all three nozzle groups are in service and full admission to the velocity compounded blading is obtained. There are, in addition to the three governor valves, two overload valves. When the first of these opens, live steam is admitted to the eighth stage of the high-pressure turbine, while the second admits live steam at reduced pressure to the pipe connecting the high-pressure and intermediate-pressure turbine. These overload valves not only allow the unit to carry loads greater than 80,000 kW continuously, should the power factor be better than that for which the generators were designed, but also permit full load to be maintained in the event of a large fall in boiler pressure or a reduction of the vacuum. The three governor valves are fixed at the front end of the turbine, as can be seen in Fig. 1 *ante*; and the two overload valves are situated behind them so as not to increase the width of the whole machine.

The first of the governor valves to open is larger than the others, as it controls a greater number of nozzles. It is also provided with a central equalising valve which opens before the main valve lifts from its seat, and only closes after the main valve is seated. The other two governor valves need no such provision, because they are only called upon to open when there is a considerable load on the turbine, and therefore a fair steam pressure already on their lower sides. All five valves are opened in order by the action of the same cam shaft. The overspeeding of the turbine is prevented in two ways. First, all the nozzle valves are shut by the action of the main governor. Should any defect in the mechanism prevent the turbine speed being controlled in this way, the emergency governors come into action and shut steam off the machine altogether. Each of these governors consists of an excentric ring surrounding the turbine shaft, and held central with it under normal circumstances by a spring. Should the speed exceed a predetermined limit, the rings fly out under the action of centrifugal force and trip the main stop valves. There are two of these emergency governors, one at the front end of the high-pressure cylinder, and the other in a corresponding position on the low-pressure side of the machine, so that the speed of each shaft is separately controlled. Arrangements are provided by which all the safety devices may be tested when the machine is running. In case of a failure of the vacuum, a pressure-controlled device on the low-pressure turbine comes into action and shuts off steam from the turbine, to avoid damage to the low-pressure cylinders and condensers. There is also an automatic atmospheric valve connected to the exhaust branch between the two condensers, which serves to prevent the pressure rising unduly.

The oil pressure for the governing gear and the bearings is supplied by means of four gear pumps, two of which are situated in the front pedestal of the high-pressure cylinder—as shown in Fig. 14—and the other pair in the corresponding bearing of the low-pressure cylinders. Three of these pumps supply oil at a pressure of about 70 lb. per square inch for the governing and the other at about 7 lb. per square inch for the bearings. The arrangement is such that the oil which has served its purpose in operating the governor gear passes then at lower pressure into the lubricating system. In order to provide the necessary oil pressure when the turbine is being started or stopped, there is a special auxiliary turbine-driven oil pump, which comes into action automatically when the main

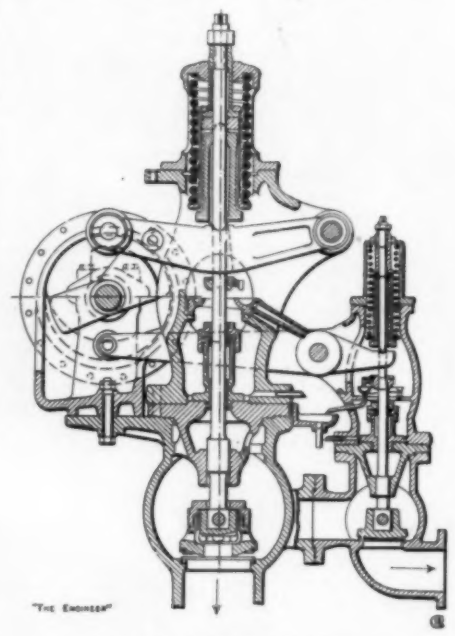


FIG. 13—GOVERNOR VALVES

stop valve is opened. As soon as the main oil pumps supply enough oil the turbine-driven pump is automatically stopped.

The first tests of one of the three machines, made by the Allgemeine Elektricitäts Gesellschaft, gave the results collected in the following table :—

TABLE III.—*Preliminary Tests of One of the* 80,000-*kW Turbines.*

Output at generator terminals, kW	61,987	36,450	18,087
Steam consumption, lb. per kWh	8·40	8·60	9·26
Efficiency at generator terminals, %	81·15	78·25	72·65
Efficiency at turbine couplings, %	85·0	83·3	80·4

During these tests the mean steam pressure at the turbine stop valve was 455 lb. per square inch absolute, and the temperature was 400 deg. Cent. The vacuum was obtained with 17,000 tons of circulating water per hour at an inlet temperature of 15 deg. Cent. During the tests the turbine could only be loaded up to the demand on the feeders, which was about 62,000 kW, or slightly more than three-quarters the normal capacity of the machine. The trials, however, were sufficient to show that the turbine is an extremely efficient machine, and that the efficiency is well maintained even at very low loads.

THE CONDENSING PLANT.

The complete unit is served by two surface condensers, each of which is set transversely under one of the low-pressure cylinders and receives steam from its two exhaust branches. The distribution of the steam, longitudinally through the condensers, is thus particularly good. The arrangement will be understood by reference to Figs. 4 and 6 *ante*. The condensers are 3800 mm. (12·46ft.) in diameter, and each contains 6155 tubes 23 mm. (·905in.) external diameter by 1 mm. (·039in.) thick, and 7470 mm. (24·5ft.) long, giving a cooling surface of 3300 square metres (35,519 square feet). The condenser tubes are of brass, having the composition 70 Cu, 29 Zn, 1 Sb.

* No. I. appeared December 7th.

The tube arrangement is illustrated in Fig. 15 below. In the upper part of the condenser are four groups of tubes with ample passage way for the steam to pass between and around them. The tubes in these groups present a large aggregate surface to the incoming steam, much of which is immediately condensed on them. To prevent the water so formed from interfering with the action of the tubes below, it is directed by guide plates so that it falls through wide vertical lanes through the tubes beneath into longitudinal channels in the lower part of the condenser. The whole design is very well thought out.

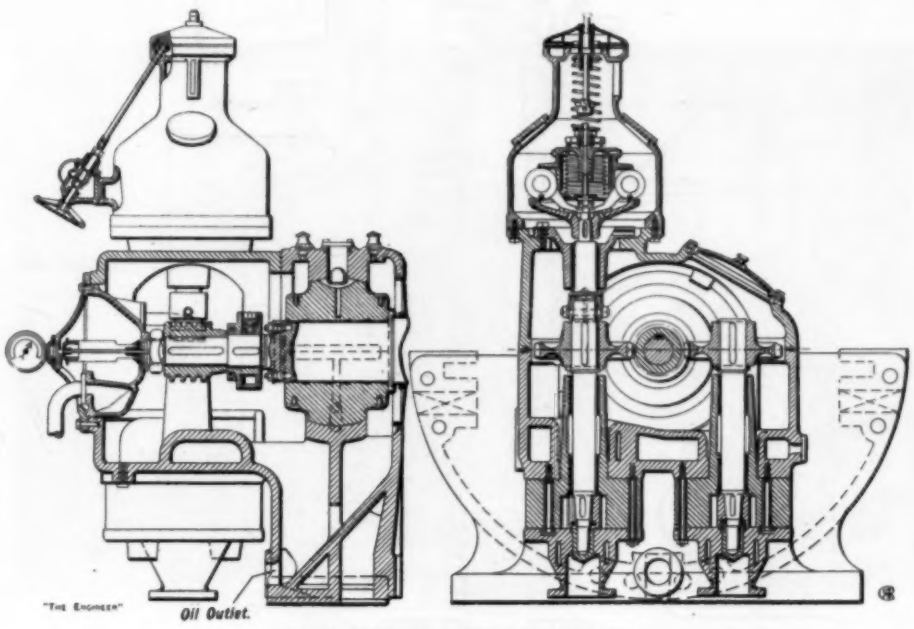


FIG. 14—GOVERNOR AND GEAR PUMPS

The steam has a progressively narrowing passage as its volume diminishes, so that its velocity is maintained. It has free access to all tubes, and the method of drainage already mentioned disposes of the water of condensation in a way at once simple and efficient. The performance of the condensers is very satisfactory, as will be seen from the following figures :—

TABLE IV.—*Tests of Klingenberg Condensers.*

Date of test	Aug. 25th, 1927
Barometer	755·6 mm.
Steam condensed per hour, lb.	547,690
Inlet water, deg. Cent.	18·4
Outlet water, deg. Cent.	27·4
Condensate, deg. Cent.	27·9
Exhaust temperature, deg. Cent.	28·5
Vac., top of condenser, per cent.	96·15
Vac., upper part of exhaust branch, per cent.	96·1

There are two sets of condenser auxiliaries of identical design and capacity for each main turbine.

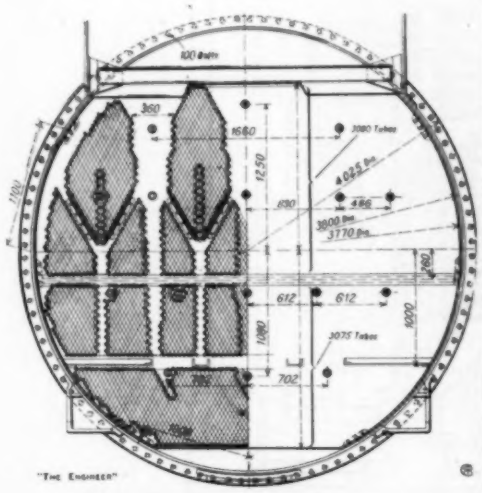


FIG. 15—CONDENSER TUBE ARRANGEMENT

Each consists of a group comprising a circulating pump, a condensate pump and an air extraction pump of the water jet type. Normally the group is driven by an electric motor, but a steam turbine is also provided. The latter, being controlled by a governor, runs idly in a vacuum, but should the speed of the set commence to fall by reason of a failure of the motor or other cause, the governor admits steam to the turbine, which at once takes up the duty of driving the pumps. When the electric drive again becomes normal, the steam is automatically shut off from the turbine by the action of the governor. The motor runs at 500 r.p.m., and is directly coupled to the circulating pump. The turbine is designed for a speed of 5000 r.p.m., and drives the circulating pump through a 10 to 1 reduction gear. To the large wheel of this gear is meshed another gear wheel by which the air extraction pump and the condensate pump are both driven at 1000 r.p.m. The turbine wheel and the various gear wheels for the whole drive are illustrated in Fig. 16. The circulating pumps deliver water into a large header pipe, supplying water to all or any of the condensers. Each of the condensate pumps belonging to a single turbine has a sufficient capacity to deal by itself with the full load condensate of the turbine—a matter of about 270 tons of water per hour. The provision of water ejector air extractors instead of the steam jet extractors used now in so many stations was decided on for practical reasons. The action of the water jets is, of course, not affected by any change in steam pressure, to which steam jets are frequently very sensitive. Furthermore, the ejector pumps are so simple that they contain nothing to go wrong, and the small inexpensive nozzle can be easily renewed in case of necessity.

THE HOUSE TURBINES.

As has been mentioned already, with each main generator of 80,000 kW, there is associated a house turbine of 10,000 kW, from which steam can be bled for feed-heating purposes. These machines are situated in the auxiliary engine-room, along with the boiler feed pumps. A view of this engine-room is reproduced in Fig. 17, in which the three house turbines can be seen side by side near the entrance pillars. In the background of the engraving is the main engine-room, in which one of the 80,000-kW sets is visible. The two engine-rooms are on the same level, and the opening between them being the full width of the auxiliary engine-room, supervision of the machinery in both is as easy as possible. A better view of one of the house sets is given in Fig. 18, and a longitudinal section through the turbine in the drawing on page 650.

The house turbines run at 3000 r.p.m. They take steam at 475 lb. per square inch and at 400 deg. Cent. The whole of the steam which passes into them serves to heat the feed water of the station, some being extracted between the high-pressure and low-pressure cylinders at an absolute pressure of 56·9 lb., and the remainder passing to low-pressure feed heaters after leaving the low-pressure cylinder at a pressure of 6·4 lb. absolute. Each turbine is designed to pass out a maximum of 143,000 lb. of steam at the pressure of 56·9 lb. The high-pressure cylinder is a straight multi-stage pressure-compounded impulse turbine. It commences with a simple impulse wheel of comparatively large diameter which serves as a governing stage. There are then twelve wheels of 600 mm. diameter and six other wheels of 800 mm. diameter. The low-pressure cylinder commences with a two-row velocity-compounded wheel, followed by eighteen

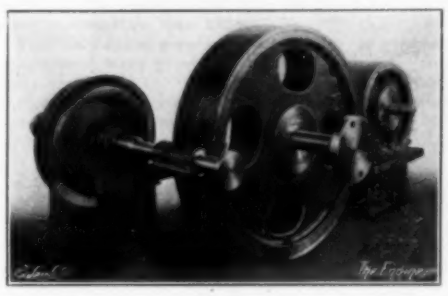


FIG. 16—GEARS FOR CONDENSER AUXILIARIES

reaction stages on a tapered drum. The mean diameter of the drum blading is 700 mm. (27·56in.).

Reference to the drawing on page 650 will show that the design of these house turbines follows closely along the lines adopted for the main turbines, of which a description has already been given. The high-pressure cylinder casing is of steel and the diaphragms of the first twelve stages, where the temperature of the steam is still high, are carried in separate inner cylinders fastened into the casing. Steam can circulate round the inner casings, so that the whole of the working parts within them are uniformly heated and troubles due to unequal expansion are avoided. The rotor of this cylinder is in one piece, the wheels being turned from the solid, with parallel sides, and the whole construction resulting in a very short and rigid rotor. The low-pressure rotor is made from a forging, with one stub end fastened in. As in the case of the main turbines, the low-pressure rotor is bored out and the shafts are also hollow. The velocity-compounded wheel, upon which the steam first acts, is fixed on the shaft with a conical bush. The construction of the bearings,

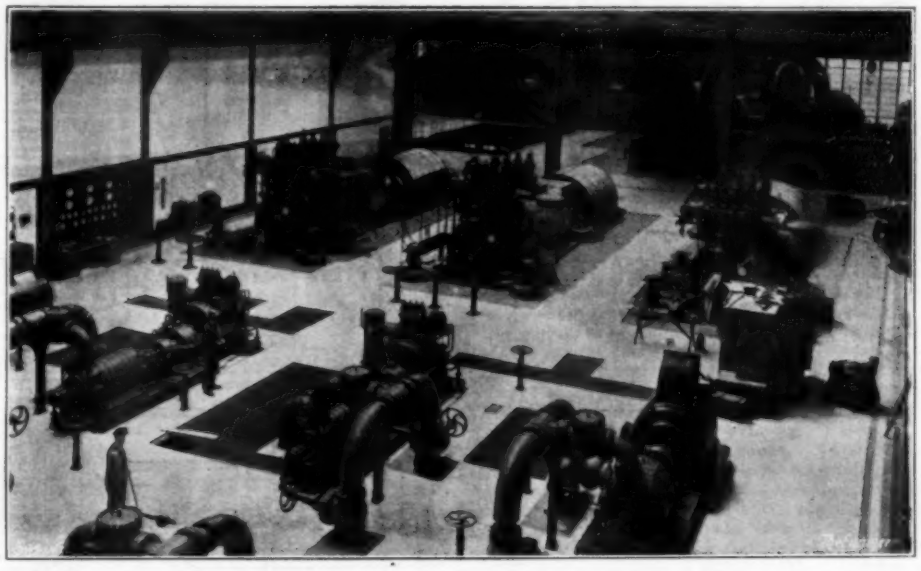


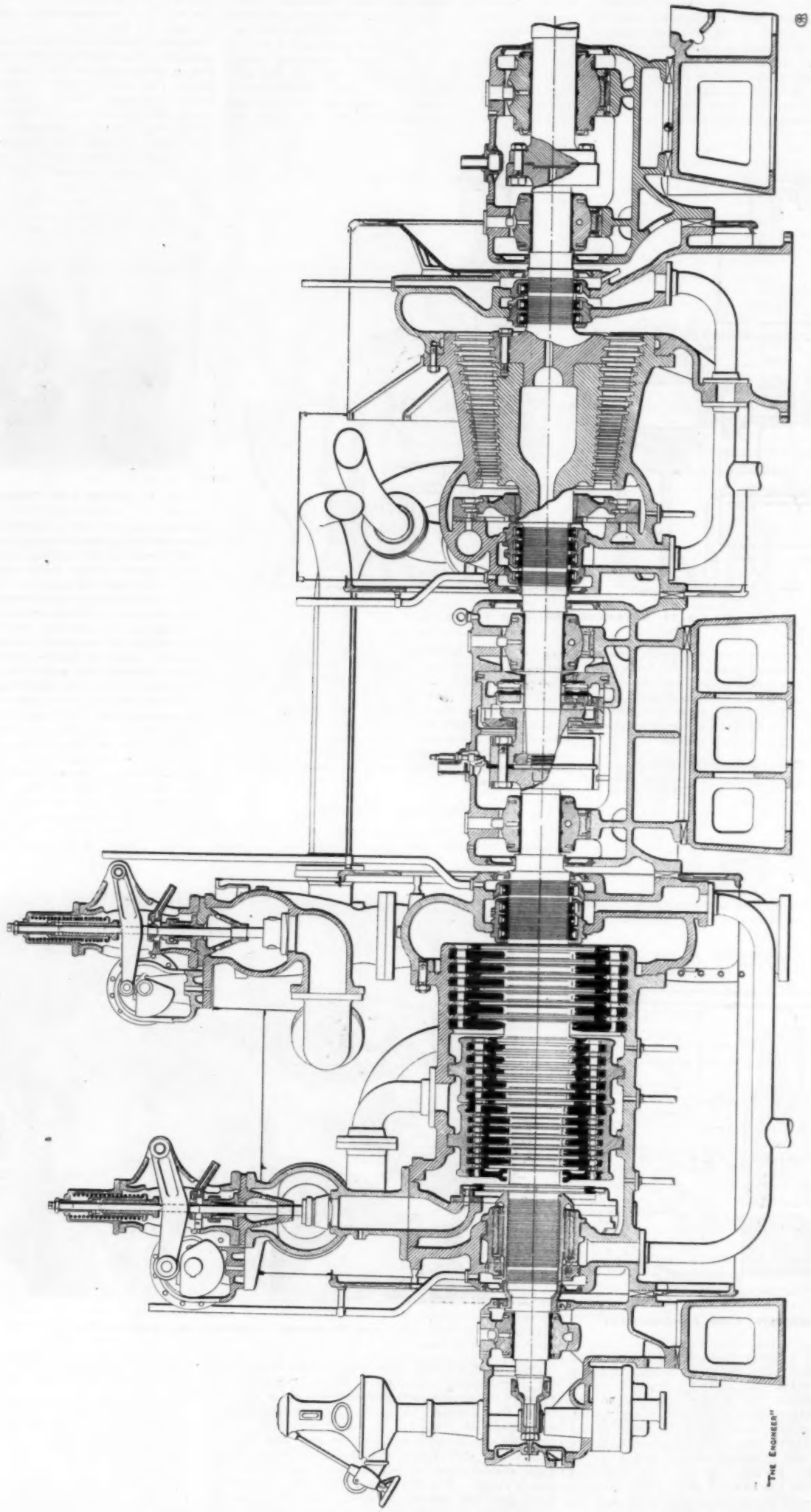
FIG. 17—HOUSE TURBINES AND BOILER FEED PUMPS

thrust blocks, glands, couplings, &c., is similar to that adopted for the main turbines and referred to above.

The method of governing of the house turbine is of interest. Live steam is admitted through five governor valves before the first stage, and steam is bled-off through four more governor valves after having done work in the high-pressure cylinder. These valves are arranged in two rows, as shown in Fig. 18. The governing gear is so designed that the action of the governor on either set of valves is controlled by the pressures at the end of the high-pressure and at the end of the low-pressure cylinders.

KLINGENBERG POWER STATION—10,000 kW HOUSE TURBINE

ALLGEMEINE ELEKTRICITATS GESELLSCHAFT, BERLIN, ENGINEERS



The control is effected by means of diaphragm apparatus acted on by the respective pressures and providing movable fulcra for the levers of the pilot valves.

The feed heating system is as follows:—The condensate pumps of each pair of main condensers deliver into a common main, their discharges into this main being equalised by surge tanks. The water from the main acts as cooling water for the jet condensers of the house turbines, being heated to about 75 deg. Cent. by its passage through a condenser. These condensers act also as de-aerators. The heated water is then pumped through a

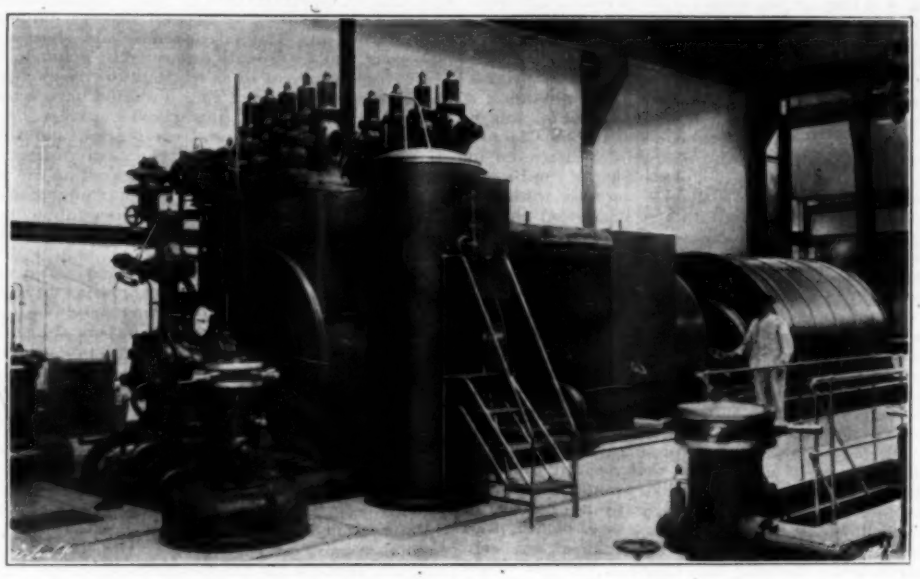


FIG. 18—10,000 kW HOUSE GENERATOR SET

second heater in which it absorbs the latent heat of the vapour produced by the evaporator. It leaves this heater at about 105 deg. Cent., and passes to a third heater which is supplied with the steam tapped off from the house turbine. In this last heater its temperature is raised to about 138 deg. Cent., at which temperature it is delivered to the economisers by the boiler feed pumps.

THE BOILER FEED PUMPS.

The boiler feed pump equipment of the Klingenberg station comprises eight centrifugal feed pumps, of

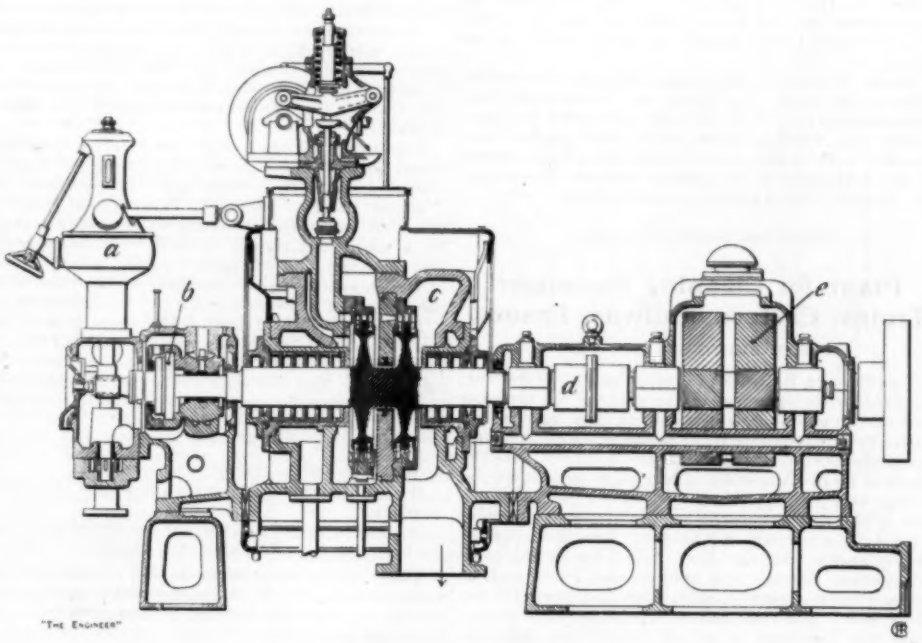


FIG. 19—FEED PUMP TURBINE

which six are driven by 6000-volt synchronous motors and the remaining pair by steam turbines, the latter pumps being considered as reserve units. Every pump is designed to deliver 435 tons of water per hour against a pressure of 590 lb. per square inch, when driven at a speed of 1500 revolutions per minute. In order to avoid interference with the action of the boiler feed regulators by changes in the feed line pressure owing to variations in the load, special pressure regulators are fitted to maintain a constant difference of pressure across each feed regulator. The pumps, which are of the seven-stage type, are designed to deal with feed water from 140 deg. to 170 deg. Cent. as a maximum. They are also capable of handling cold water without damage to impellers or stuffing-boxes, by so great a difference from their designed temperature. The motor-driven pumps are direct coupled, but the others are driven through reduction gearing. The turbines employed are rated at 650 kW at 6000 revolutions per minute. Each consists of a two-stage machine, each stage comprising a two-row velocity-compounded wheel. The turbine wheels are solid with their shafts, and the latter are packed with carbon glands. The longitudinal section of a turbine, reproduced in Fig. 19, illustrates the general construction. The machines take steam at 475 lb. absolute and 400 deg. Cent., and exhaust against a back pressure of about 42 lb. absolute, the exhaust steam passing to the feed heating system. In view of the high density of the steam, and the comparatively small rating of the turbines, partial admission had to be adopted in order to get satisfactory proportions of the wheels and blading. Governing is effected by four valves controlling the admission of steam to an equal number of nozzle groups. The two steam-driven pumps and one of the electrically driven pumps are to be seen in the foreground of Fig. 17.

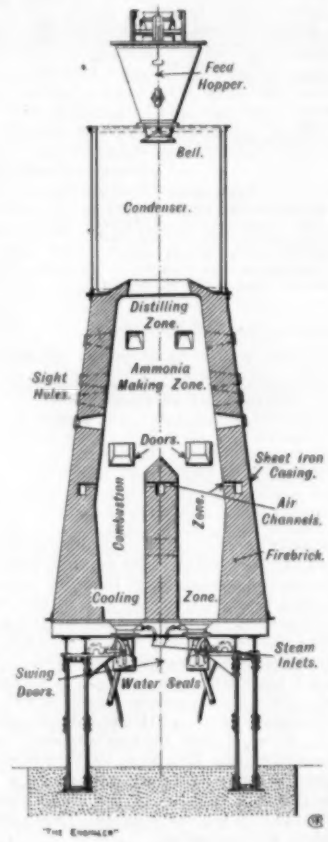
The 80,000-kW turbines, with their generators and condensing plant, the 10,000 house sets and the boiler feed units were all designed and constructed by the Allgemeine Elektricitäts Gesellschaft, of Berlin, which firm was also responsible for the general design of the Klingenberg station. We are indebted to the company for giving us facilities for the description of the plant with which we have dealt above, and desire to express our particular thanks to Dr. Troeger, Prof. Dr. E. A. Kraft, the director of the turbine department, Dr. Robert Pohl, the director of the generator department, Dr. Kurt Lubowsky, and other gentlemen connected with the company for their courtesy on the occasion of our visit.

Low Temperature Carbonisation Plant at Dalmarnock.

By JOHN B. C. KERSHAW, F.I.C.

THE issue of THE ENGINEER for March 11th, 1927, contained an article upon the "World's Future Supplies of Liquid Fuel," by the present writer, in which a reference was made to the plant for the operation of the MacLaurin low-temperature carbonisation process, erected by the Glasgow Corporation Gas Committee at its Dalmarnock Gasworks. The figures given in that article were based upon the estimates of the yields of coke, oil and gas obtained in the early trials of the process. During a recent visit to Glasgow the writer was afforded an opportunity for inspection of the MacLaurin plant, and in the following article he records his impressions of this visit and publishes figures taken from the annual reports of the Gas Department of the city, which show the financial results of the actual working of the plant for the two years ending May 31st, 1928.

The MacLaurin process, readers may be reminded, is operated with producers of the continuous internally heated type. Each producer is of square section and is 36ft. in height by 8ft. in diameter at the widest point, and resembles in appearance a small blast-furnace. The producers taper both upwards and



VERTICAL SECTION THROUGH RETORT

downwards, and the coal is introduced at the top in 1-ton charges at intervals of one hour, and requires from twenty-five to thirty hours for its passage through the retort. The throughput of each retort is therefore at the rate of 20 to 24 tons a day, and the installation at Glasgow, consisting of a battery of five retorts, has a capacity of 100 tons per twenty-four hours. According to the capital account on May 31st, 1928, the expenditure upon the plant has amounted to £47,588 and the charges for interest and sinking fund on this outlay amounted to £3413 per annum in the last year's account. No additions or alterations have been made since the plant was first put into operation, but the process cannot be said to have emerged yet from the initial stage of its development, for according to the revenue accounts there was a net loss of £7304 for the year ending May 31st, 1927, and a net loss of £2391 in the following year. In explanation of the very large loss incurred in 1926–27 it may be stated that the plant was only operated for six out of the twelve months, since the trouble in the coal mining industry and the General Strike of that year interfered with its operation for the full twelve months. The charges for interest, sinking fund and depreciation covered the whole year, and a large stock of carbonised fuel remained unsold at the end of the year and had to be valued at a low price.

Tables I. and II. give the details of expenditure and receipt for the two years, as given in the Glasgow Corporation gas accounts, and the figures will be examined with considerable interest by chemists and engineers now occupied in the development of similar processes. The figures for the volume of gas

produced and for the total gallons of the crude oil obtained during each twelve months' period were not included in the original accounts; but the missing figures are now available, and with the aid of them the yields of gas and oil per ton of coal carbonised have been worked out and are presented in tabular form in Table III., where they can be compared with the yields obtained during the experimental investigation of the process. It will be noticed that while a charge for rates and taxes is included in the revenue account for the year ending May 31st, 1928, no similar charge is included in the account for the earlier period, since the plant was considered then to be in

Table I.—*Revenue Account of the Smokeless Fuel Department of the Glasgow Corporation for the Year Ending May 31st, 1927.*

Expenditure.	£	s.	d.
Coal, 10,214 tons at 26s. 6·42d.	13,552	1	11
Wages	2,434	11	5
Repairs, &c.	1,454	5	0
Railway carriage	295	4	4
Interest, sinking fund, and depreciation	3,253	2	6
	£20,989	5	2
Receipts.	£	s.	d.
Smokeless fuel sold, 2046 tons at 33s. 6·5d.	3,727	10	2
Gas, 332,899,796 c. ft. at 1¼d. per therm	4,270	8	0
Oil, 179,379 gallons at 6·3d. per gallon	4,770	17	3
Kincole unsold and used next year, 2133 tons	916	5	0
	13,685	6	5
Balance carried to revenue account (loss)	7,304	4	9
	£20,989	5	2

Table II.—*Revenue Account of the Smokeless Fuel Department of the Glasgow Corporation for the Year Ending May 31st, 1928.*

Expenditure.	£	s.	d.
Coal, 13,482 tons at 18s. 1·5d. per ton	12,219	7	5
Wages	3,138	12	2
Repairs, &c.	2,281	2	9
Rates and taxes, &c.	2,191	17	3
Interest and sinking fund	3,413	6	5
	£23,244	6	0
Receipts.	£	s.	d.
Smokeless fuel sold, 7048 tons at 21s. 4d.	7,546	3	0
Smokeless fuel used in works (2133 tons) and undercredited in previous year's account	1,798	10	8
Gas, 413,160,785 c. ft. at 2d. per therm	6,697	0	0
Oil, 230,778 gallons at 4d. per gallon	4,585	11	9
Stock of coal, 258 tons at 17s. 6d. per ton	225	15	0
	20,853	0	5
Balance carried to revenue account (loss)	2,391	5	7
	£23,244	6	0

Table III.—*Estimated and Actual Yields of Smokeless Fuel, Gas, and Oil by the MacLaurin Process.*

	Estimated.	1926–27.	1927–28.
Smokeless fuel (in cwt.)	Av. 10·50 (9·30 to 11·77)	8·18	10·66
Gas (in c. ft.)	Av. 30,000 (27,000 to 33,000)	32,592	31,243
Crude oil (in gallons)	Av. 15·90 (14·50 to 17·30)	17·50	17·40

the semi-experimental stage of its development. It will also be observed that the revenue from the sale of the gas and of the crude oil together exceeds considerably that derived from the sale of the smokeless fuel, or "kincole," as it is termed in Glasgow, and that during the year ending May 31st, 1928, the gas used for heating the vertical gas retorts in the Dalmarnock Gasworks was taken at a charge of 2d. per therm, while in the previous year it was credited only with a value of 1¼d. per therm. With regard to the "crude oil" revenue, this product was sold during the twelve months ending May 31st, 1927, to the Chemical Department of the City Corporation, at a price of 6·3d. per gallon; whereas in the second period the price obtained was considerably less and only amounted to 4d. per gallon.

With reference to the possibility of obtaining a higher revenue from the MacLaurin tar oils, it may be explained that the system of valuation in use at Glasgow is based on the following method:—The products are sent free of charge from the Gasworks to the Corporation Chemical Works, where they are treated in the ordinary manner, and the Gas Department is then credited with the total revenue obtained, after deducting the working and other charges of the Chemical Department. It is at present considered impracticable to carry out separate treatment of the MacLaurin oils, since that would involve the erection of special plant, and the estimated increase of revenue does not warrant such an expenditure at the present time.

The accounts, it will be observed, give no separate value for the value of the ammonia recovered; but the writer is informed that during the year 1927–28 the revenue obtained from this by-product amounted to £203 16s. 6d., which is included in the figure of the receipts from the sale of the crude oil.

Considering now the future of the process, it does not seem possible to obtain a larger revenue at present from the sale of the carbonised product, for the demand and sale for it is not increasing so rapidly in Glasgow as was hoped would be the case when the plant was first erected. Up to May 31st, 1928, a total of only 9094 tons had been disposed of, whereas 23,696 tons of coal had been carbonised, and a considerable amount, therefore, of smokeless fuel was left in 1927 to be consumed in the works where it was produced. In connection with this prejudice against "kincole," which seems to exist in Glasgow, it may be stated that it is partly due to the fact that some of the raw coal, which has been submitted to the process of low-temperature carbonisation in the Dalmarnock plant, has proved quite unsuitable for the manufacture of a domestic fuel, since the coke produced, when heated, was subject to violent crepitation, even when in the perfectly dry state. The cause of this phenomenon is one which requires further study, for the usual explanation that it is due to the moisture which remains in the pores of the coke after quenching by water will not explain the experience of the difficulty at Glasgow, since in this case the coke had not been quenched after passing through a retort at 700 deg. Fah. The second cause of the prejudice against "kincole" is the price at which it is retailed, for so long as consumers have to pay more for the smokeless fuel than for raw coal so long will they go on using the latter, although theoretical considerations as regards radiant heat may prove the carbonised product to offer much better value for heating purposes.

The best hope for the future success of the process would seem to depend, therefore, upon obtaining a larger revenue from the sale of the crude oil and of the gas. Mr. W. B. Smith, the member of the Glasgow City Gas Committee, who is specially interested in the process, on the occasion of the visit of the British Association members to the Dalmarnock works on September 11th, referred to the suggestion that it might be possible to increase the revenue from the gas by distributing it in separate mains within a short radius from the works. The gas, if sold as a power gas at a price of about 2d. per therm, would, he said, prove more economical than raw coal in many manufacturing industries. It must be noted, however, that whereas in the 1927 revenue account this gas is only credited at a price of 1¼d. per therm by the Gas Department, when used for heating vertical retorts, in the 1928 revenue account the gas is credited with a price of 2d. per therm, and in the twelve months ending May 31st, 1928, it produced an income of £6697, or nearly as much as that derived from the sale of the "kincole." Nothing would be gained, therefore, by distributing the gas to other works in the vicinity at Dalmarnock, unless a higher price than 2d. per therm would be obtained by such distribution. Keeping this figure in view, it would be interesting to ascertain how Mr. MacLaurin proposes to distribute the gas at a rate to manufacturers of 1·1d. per therm.

With regard to the possibilities of increasing the income derived from the crude oil, Mr. W. B. Smith stated on the same occasion that it could be employed directly, without distillation, as a substitute for creosote oil. The price of creosote has fallen so considerably, however, during the last two years that it is doubtful whether the substitution of the MacLaurin low-temperature oil would offer any advantages. The constitution of the oil differs also very considerably from ordinary retort oil, and it is probable that in the course of time a satisfactory method of working up this oil will be found and that an increased revenue will be obtained from it. Mr. MacLaurin himself is working upon the problem offered by the treatment of the oils produced by his process, and its future economic success would seem to depend very largely upon the results of his efforts.

Finally, it may be stated that although the capital expenditure upon the plant at Dalmarnock has amounted up to date to £47,588, that total does not include the working losses which have so far been incurred in its operation, but these have been carried to the debit side of the general revenue account of the Glasgow Corporation gas undertaking.

Plant for Cleaning Passenger Trains, Eastern Railway, France.

By J. T. BURTON ALEXANDER.

The Eastern Railway of France had, after the war, to consider the question of the making up, cleaning and effecting running repairs of its passenger trains, with a view to facilitate those operations and to reduce by mechanical means the expense of labour. As the result of its investigations it decided to lay out special sidings at a point 6½ kiloms. from Paris, on the south side of the line to Strasbourg and Basle and parallel with it for a distance of 2 kiloms. Two lines, one for the up and one for the down trains, assure the communication between the sidings and Paris, and, at hours when the traffic is light, other lines are made use of as well. The time taken for the journey to and from the terminus is about twenty-five minutes. These sidings are known as the "Garage de l'Ourcq."

The objects of the organisation are to effect the running repairs and the cleaning, both inside and out, of the passenger rolling stock with the lowest possible labour charges, and, by methodical examination of the coaches, greatly to lessen the heavy repairs and the laying up of the rolling stock consequent on such repairs.

The Ourcq sidings, as will be seen from the accompanying plan, comprise a big gridiron of lines composed of several units, each of which has a special object and is so arranged as to ensure the efficient movement of each train from the moment it enters the sidings on arrival until its departure, ready to start cleaned, overhauled, and the replacement of any defective vehicles.

Arrival and Inspection.—The dirty trains arrive from Paris on the "Reception Sidings"—see A on the plan—and the engine which has hauled them goes off, while another engine known as the "Middle Engine" takes them and finally pushes them over one of the two inspection pits—see B on the plan—where they are inspected as will be described later.

Making Up the Train.—As soon as the inspection is finished a second engine—the "Making-up Engine"—takes the train from the inspection pit and makes up the train in accordance with the requirements of the "Working Book" of the Traffic Department, either by cutting out or adding coaches, or changing their position in the train, or, in case of defective vehicles, replacing them by spare ones, kept ready on the dead end lines—marked "Reserve Sidings" C on the plan. These latter lines are short and numerous, and are directly connected by points to the main cross-over road so as to facilitate the shunting and so that each type of vehicle should have a road to itself—bogie coaches, four-wheeled coaches, brake vans, first, first and second composites, and third class—and that only one shunt is necessary to pick up the vehicle required. Periodical inspection ensures that the various coaches are in perfect running order. The carriages that have been cut out go first on to one of the "Reserve Sidings" and afterwards to the shops for the necessary repairs.

Washing.—The train, when ready marshalled with its coaches in their proper order, is pushed on to the sidings specially provided, "Waiting to be Washed," which are marked D on the plan. There the bodies are washed by a special mechanical washing machine, which is described later.

Repairs.—A third shunting engine, the "Washing Engine," now takes the train from the "Waiting for Washing" roads and pushes it past the washing machine which is on the road being traversed by the train, the speed being slowed down during the washing process. The train is then pushed on to the siding E, whence it is taken to one or other of the series of "Preparation Sidings"—marked F and G—where the running repairs are carried out. The sidings H are specially kept for the accommodation of trains which are ready to go out cleaned and overhauled, so as to free the "Preparation Sidings."

Time Table.—The movement of each train is carefully timed and plotted on a graph which shows for each train:—

(1) The arrival time at the receiving sidings;
(2) The time allowed for the inspection, making up and washing;
(3) The arrival time at the "Preparation Sidings;
(4) The time the train stands on the "Preparation Sidings;"
(5) The time allowed for the overhaul or repairs, as they must be finished before the cleaning is commenced, so as to avoid the workmen being in the carriages while work is going on or their bringing in dirt after the cleaning has been effected.
(6) Time of starting for Paris. On the graph the number of the siding where each train stands is given.

The movements of each of the three shunting engines is also marked by a dotted line so that their movements can be followed. By this arrangement, and provided that each train arrives at scheduled time, fifty trains a day can be passed through the different operations.

Practically all the points are worked from three signal-boxes, the first of which controls the receiving sidings and the two others the "Preparation" and "Trains Ready" sidings. These signal-boxes are fitted with tell-tales, indicating when a road is occupied by a train, and signals worked from them protect any movement on the main running lines. As each of the shunting engines operates within fixed limits, the danger of collision is reduced to a minimum.

Inspection of the Trains.—The inspection of each train is made on one of the two pits marked B on the plan. Each pit is 260 yards long and receives a complete train. The side walls are furnished with electric lamps so as to light up the underframes of the coaches and the running gear.

Three colour signals cover each pit:—

(*a*) White, when the pit is unoccupied;
(*b*) Red, when the pit is occupied by a train under inspection; and
(*c*) Green, when the train is inspected and ready for the second or "Making-up" engine to couple on.

These signals are automatic and are controlled by track circuits, but the red is changed to green as soon as the inspection is finished by the *personnel*, so as to ensure perfect safety.

The time allowed for inspecting the trains is fixed, and the longest trains do not require more than 25 minutes. Five men are sufficient for the work—one in the pit, one on each side of the pit and two for the interior of the coaches. The defects discovered are noted on two cards, one for the exterior and one for the interior of each train. These cards are conveyed by an overhead wire to the office of the "Preparation Sidings," so that cards fixing and detailing the work for the workmen can be prepared without delay.

Washing Machines.

The washing of the outsides of the coaches is done by a special machine which, by purely mechanical means, washes and cleans the outside of coaches of

all classes and types, including the double-deck coaches used on suburban trains, thereby abolishing all the labour with long-handled brushes and pails of water, which was formerly necessary.

This machine—illustrations of which are given on page 660—was constructed in the shops of the company, and is composed of four pairs of vertical cylinders, four of which are 11ft. 5½in. and four 8ft. 5in. high, arranged four on each side of the track. These cylinders are fitted with thongs of cloth fixed to the cylinders at one end and free at the other. The higher of these cylinders are for the double-decked suburban coaches.

Each pair of cylinders is worked by an electric motor, the thongs in adjacent cylinders being revolved in opposite directions, and the speed is so fixed that the centrifugal force of the cloth may be sufficient to clean the dirt without damage to the paint and varnish, the window panes or the external fittings, such as door handles, &c.

The water used is under a pressure of 56 lb. per square inch, and as the pressure in the supply piping is only half that value, an electric pump increases it, and vertical pipes with numerous perforations direct jets of water on to the sides of the carriages, as well as on to the washing cylinders. To ensure the highest efficiency, the jets of water are projected at various angles.

The speed of the train as it passes the washer is between 1¼ and 2 miles an hour, and a special speed indicator on the engine shows whether the speed is correct. The electric control for starting and stopping the washing machine is worked by a shunter, who travels on each train. A special man for this purpose is not necessary, as the controls are placed on a raised platform some yards before the machine is reached and the shunter, who travels on the front brake van, steps on to the platform as he passes and operates the control of the electric pump and the lever of the water cock to the cylinders. While the train is passing along, which it does in about 8 minutes, the shunter walks round to a second platform behind the machines, and when the rear brake van has passed, he closes his controls and the water cock to the cylinders and steps on to the rear brake van.

The track between the rails is furnished with a central cemented drain, which discharges the dirty water into a sump. The amount of deposit which collects in the sump proves the efficiency of the work done. Actually, the cleaning is better done than it is done by hand.

From the point of view of economy, as compared to washing by hand, we understand that in spite of a greatly increased consumption of water and the expenditure of about 300 kilowatt-hours of electricity a day, the annual saving exceeds 200,000f., or over £1600 at the present rate of exchange.

It is hardly necessary to point out that the doors of the coaches and the windows must be water-tight, and that all must be previously carefully closed. In spite, however, of much foreign stock, chiefly Alsace-Lorraine and German, which is mixed up with the company's coaches, no difficulty appears to be experienced on this account.

PREPARATION AND OVERHAUL.

Repairs.—All the repairs that can be done without sending the vehicles to the shops or without exceeding two hours in time, are done on the "Preparations Sidings."

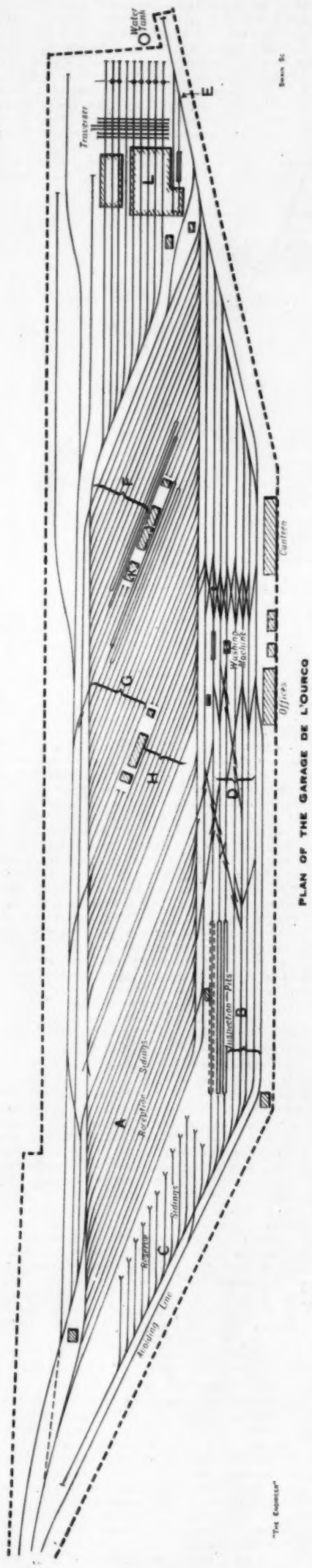
We have already seen that the inspection at the pits has noted all the repairs to be done, and they have been marked on cards and sent to the offices of the siding. This information enables an individual card to be made out for each separate job—either as concerns repairs, trials, or replacement, and the time allowed for such. These cards are given to the leading hands before the work is begun, and the workman is at once informed what repairs have to be effected, and on which coach. These men also supervise the work and see that it is properly done, and ensure that any further work found necessary while doing the specified work, is attended to. When all has been finished, the foreman again inspects the work, and the head of the Ourcq garage himself makes periodical visits to make sure that everything is proceeding satisfactorily. Premiums are given to the workmen for time gained in executing the work as compared with the time allowed.

The buildings and installations generally have been planned and carried out in an efficient manner. The office—marked "J" on the plan—for arranging the work is centrally placed close to the stores, with a store and two small shops between the two sets of preparations sidings, and labourers carry all stores and tools to the workmen, so that the latter lose no time. A special shop is provided for the upkeep and varnishing of the window frames.

The handling and transport of all the material is effected by light electric lorries and trolleys, which can be raised and which run on special tracks. Between each track the ground is concreted so as to facilitate cleaning. The refuse swept from the compartments is put into baskets fitted with wheels, which are hauled by tractors to a machine for loading into wagons.

Covered culverts are laid between each track to contain piping for :—

(1) Compressed air for testing the brakes for furnishing power for pneumatic tools ;



PLAN OF THE GARAGE DE L'OURCQ

(2) Steam, to test the steam heating and to heat the train before it starts back to Paris in cold weather ;

(3) Water, for cleaning and filling the various reservoirs on the coaches ;

(4) Gas to charge the lighting reservoirs of those coaches in which electric lighting is not installed ;

(5) Electricity, for lighting and for driving the vacuum cleaners ; and

(6) Electricity for recharging the accumulators on the coaches.

Cocks and plugs are fitted at short intervals all along the culvert to facilitate the use of these lines. Several of the sidings are provided with inspection pits for their whole length, and at regular intervals each train is passed for special examination of all the running gear and brake equipment.

The motive power is generated in a separate building—marked K on the plan—in a central position near the office J. Its equipment comprises two boilers, two air compressors, and machines for charging the electric accumulators of the trains and of the electric lorries.

Cleaning.—The cleaning only begins when the overhaul and repairs are completed, and all the workmen have finished. The whole of the polishing of brasswork and of glass, cleaning of cushions and carpets, &c., is done by unskilled labour, under the supervision of foremen. The workers are well supplied with vacuum cleaners, so as to ensure a speedy and hygienic cleaning, and it is they, too, who fill the various water tanks and also complete the external cleaning of the coaches, should the washing machine not have done it properly, or in case cleaning in the manner described cannot be carried out, as, for instance, during a hard frost when the water would freeze. The washing of the cushion covers, towels, &c., is done in a laundry belonging to the company at its Noisy le Sec shops, and is taken backwards and forwards in motor lorries.

Each train is inspected by the head inspectors before leaving the garage to see that all repairs have been done and that all is perfectly clean. The Traffic Department has one of its officials permanently at the "Preparation Sidings" to ensure the trains leaving on booked time.

REPAIR SHOPS.

The vehicles to be repaired are marked at the Inspection pits, and, if the repairs are such that the time is insufficient for them to be done on the "Preparation Sidings" the vehicles are passed on to the repair shops.

The shops, which are marked L on the plan, are at the far end of the sidings and are composed of four bays, 311½ft. long and 39ft. 8in. wide. The inside bay is higher, so as to enable an aerial traverser to be fitted. Nine independent roads, terminating in dead ends, of which five traverse the shop, serve this building. An electric traverser, 65ft. 7in. long, which takes the longest bogie coach in service, enables each road to be easily served, and capstans are fitted as well. The extremities of these roads are used for the storage of wheels and bogies.

This plant has been in daily use for over two years, and has given perfectly satisfactory results. It may seem that the inspection pits are short, but they take the longest train that can be put in a platform at the Paris station, and the new station, which will, of course, have much longer platforms, will not be finished for another three years at the earliest. It is important that the time-table should be adhered to, but even when trains are late, especially the main line ones, the work is done and the trains are properly inspected.

When I visited the installation I was struck by the work done by the washing machine. The outside of the train was clean, and once the inside was polished and cleaned by the vacuum cleaners, the result was most satisfactory. All the main line trains are cleaned and washed after each run. Suburban trains have a regular schedule for passing through the plant, as they are less dirty than the long-distance trains.

I must congratulate Monsieur Duchatel, Ingénieur en chef, matérial et traction, and Monsieur Monet, who, at the time of my visit, was Ingénieur Principal Adjoint à l'Ingénieur en chef, matérial et traction, and is now Ingénieur Principal des Etudes du Matériel et traction, on the results achieved, and thank them for the facilities afforded me for preparing this article.

INSTEAD of providing the high direct-current potential necessary on the anodes of vacuum tubes by primary or storage batteries, successful attempts have been made with high-voltage generators. Built similarly to the original Thury machines, a number of modern improvements have been introduced in this equipment giving such perfect commutation that voltages as high as 12,000 may now be obtained from one commutator. Greatest attention must be paid to slot insulation. It is not unusual to have a copper fill factor of only 3·5 per cent. in the slots of these machines, the remainder representing the necessary slot and wire insulation. Micanite, as thick as 0·14in., has to be used to insulate the individual commutator bars between which may be a potential of up to 250 volts. It seems that, with present experience, such generators can safely be built for as much as 20 kV per commutator in sizes to 20 kW.

The Smithfield Club Show.

THERE seems to be a tendency in some circles to decry the annual Show of the Smithfield Club as viewed from a mechanical aspect, on account of the fact that the apparatus exhibited is so familiar that it hardly needs exhibiting. Nevertheless, we have found our visits to the Show to be instructive, and it seems to us that the present Show, which closes to-day, emphasises two new phases in the mechanisation of our land industries.

We have in the past commented, in connection with these Shows, on the gradual supersession of the steam engine by the internal combustion unit, for general farm purposes, and it now appears that the change from the old conditions is getting even more accentuated. The exhibits at the Show lead one to believe that the agriculturist is not merely content to use an oil engine as his prime mover, but that he also insists on that engine being capable of utilising the cheapest grade of fuel obtainable. In other words, petrol engines, even for comparatively small powers, are giving place to heavy oil engines, which may be started directly even when they are "stone cold."

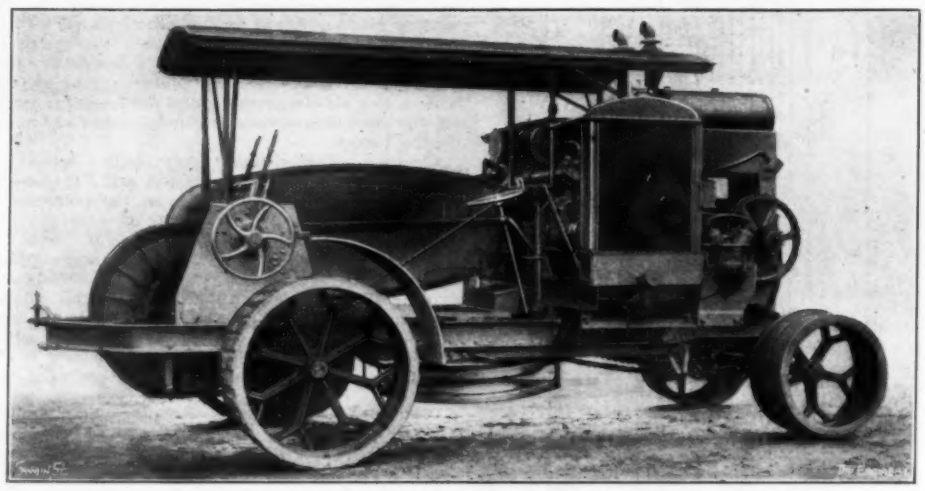


FIG. 1—HEAVY OIL ENGINE PLOUGHING WINDLASS—McLAREN

There is another general impression which one gathers in walking round the mechanical parts of the Show, and that is the importance which has accrued to the refrigerating industry since the recent legislation was enacted with the idea of checking the use of preservatives in foodstuffs. Even here, however, we cannot see any really striking originality in the exhibits.

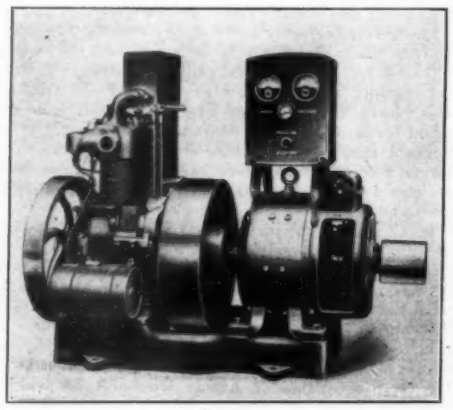


FIG. 2—LIGHTING SET—BLACKSTONE

Reverting to the subject of the heavy oil engine, one of the most striking examples is that of the ploughing machine, illustrated by Fig. 1, on the stand of J. and H. McLaren, of Leeds. It is equipped with a four-cylinder 30 horse-power engine of the Benz type, which we have already described. The interest in this machine does not, however, centre round that actually at the Show, but in another—not exhibited—of precisely the same style, with the addition of a supercharger. The supercharger is a simple rotary air compressor, driven off the crank shaft by belt, and is adopted for the following reason: The ploughman is generally in the habit of dropping his plough into the ground at the headland to such a depth that the engine can just keep it moving. Then, as the furrow extends and the wire haulage rope is wound up on to the drum, the mechanical advantage of the engine decreases, and possibly passes beyond the limit of torque. The supercharger, however, overcomes this trouble, as it is controlled by a flap which lies on the coils of rope on the drum. As the rope is wound up on to the drum and the effective diameter increases, this flap opens the valve of the supercharger, and consequently increases the capacity of the engine, so that it can overcome the increasing torque and yet maintain full working speed. The makers claim that this 30 H.P. engine can be run at full load on a consumption of 1·6 gallon of Diesel oil per hour. On this stand there are also a tractor driven by the same type of oil engine as that fitted in the ploughing windlass, some agricultural implements and pumps.

Another example of the use of the heavy oil engine for agricultural work is on the stand of John Fowler and Co. (Leeds), Ltd., of Leeds. In this case the M.A.N. type of engine has been adopted, and that exhibited is of 70 horse-power, and has four cylinders. The cylinders have detachable heads, which can easily be removed for cleaning, and the overhead valves are operated by push rods and rocker levers. This design gives the simplest possible construction and control. A special feature of the M.A.N. engine is that the number of cylinders in use can be cut down, and much better fuel consumption obtained in consequence. For easy work, half the available cylinders can be used, and for running light the number can be reduced to one cylinder only by cutting off the fuel supply entirely from the other cylinders. Pressure lubrication to main bearings and big ends is employed on the same lines as for ordinary motor car work. A governor is fitted to prevent racing of the engine. The whole engine is enclosed to exclude dust and dirt, but the covers can be easily removed to obtain access to any working parts which may require adjustment. The fuel injection nozzles are very simple in form, and have no springs or valves to cause trouble. The transmission gear from the engine to the wheels and the rope drum is totally enclosed and runs in oil. It gives three ploughing speeds. All the toothed wheels in the gear are machine cut. The weight of the machine in running order is 8¼ tons, and it has hind wheels 5ft. 6in. in diameter by 16in. wide. The front wheels are 3ft. 11½in. in diameter by 10in. wide on the tread.

Among the other oil engines exhibited those of Blackstone and Co., Stamford, make a fine display. They include the 1½ kW electric lighting set illustrated by Fig. 2. It is driven by a 3·5 horse-power engine, which runs at 825 revolutions per minute. The engine itself is of the normal Blackstone type, but it is equipped with a new form of regulator, working in conjunction with the inlet to the carburetter, which is operated by the governor on the crank shaft. This regulator takes the form of a circular louvre-like device, which controls the air inlet, and consequently the quantity and quality of the mixture going to the combustion chamber. The petrol tank of this set has a capacity of 1½ gallons, which, at normal full load, gives a running time of about four hours—the actual fuel consumption at full load is 2½ pints of petrol per hour, and the requirements in the way of lubricating oil amount to about one pint for every 32 hours of running. The larger engines on this stand are mostly of the spring-injection type, for burning heavy oil, but as we have dealt with them on several previous occasions, it is not necessary to enlarge upon them here.

On the stand of Ransomes, Sims and Jefferies, Ltd., Ipswich, we had some conversation on the subject of the use of electrical machinery for agricultural purposes. This firm is, we believe, endeavouring to popularise the use of electric motors for driving farming machinery, but, like many others, finds that the great variety of supplies provided throughout the country prevents the manufacture of electric motors, for such purposes, at a price acceptable to the purchasers. The firm in question has, however, produced a very handy form of portable electric unit, combined with a drum for the flexible lead, which should help to popularise electric power in the countryside.

On the stand of Clayton and Shuttleworth, Ltd., Lincoln, we noticed that there has been introduced a refinement in the way of the springing of steam wagons, with the idea of making them specially applicable to the carriage of such fragile material as light furniture. Over and above the usual springs for carrying the general weight of the load there is, on these machines, a secondary set of springs, which only come into action when road shocks produce abnormal vibrations.

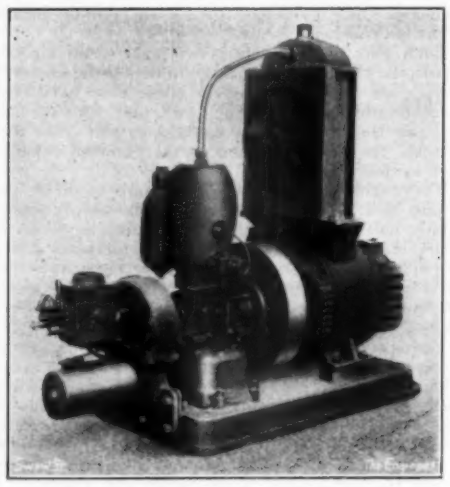


FIG. 3—LIGHTING SET—PETTERS

There is a new electric lighting set on the stand of Petters Ltd., Yeovil, which is noteworthy on account of the fact that it is intended to run on a circuit directly, without the assistance of a storage battery of any great capacity. This set, which is illustrated by Fig. 3, is of 950 watts capacity, and is driven by a 1½ horse-power engine. The outstanding feature is the use of an auxiliary starting motor, in place of the use of the main dynamo for starting the engine, so that a comparatively small accumulator will serve the necessary purpose. The speed of the engine is controlled by a centrifugal governor, which regulates the consumption of petrol in proportion to the number of lights in use. When current is no longer required the house switch can be operated without going anywhere near the actual installation itself. If desired additional controlling switches, may be installed in any part of the house. The advantage of starting the engine from special switches, and not from any switch in the house, is that it saves all unnecessary running of the engine, and arrangements may be made to place the controlling switches under lock and key, to prevent unauthorised tampering.

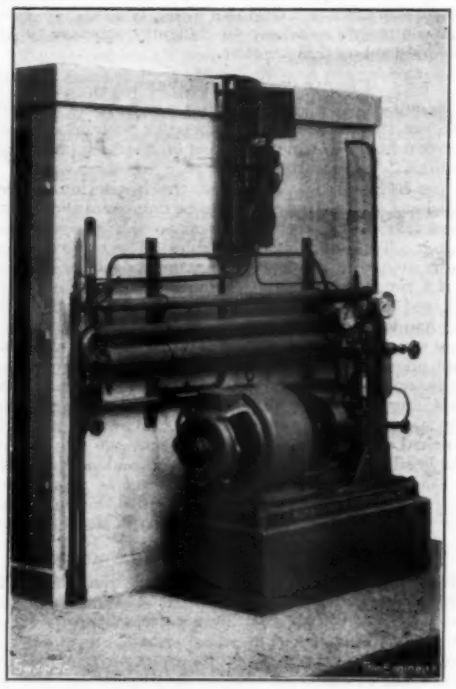


FIG. 4—REFRIGERATOR—PULSOMETER

Reverting to the other general idea inspired by the Show, that of refrigeration rather than chemical preservation, many firms are showing machinery for such purposes. They include the Pulsometer Company, the Lightfoot Refrigerating Company, J. and E. Hall, the Kelvinator Company, John Kirkaldy, Ernest West, and several others.

Of these refrigerating plants, that exhibited by the Pulsometer Engineering Company, of Reading, is illustrated by Fig. 4, The chief feature of it is the entirely automatic control. Thermostats are provided to start and stop the driving motor according to the temperature of the chamber which it is desired to cool, while valves are arranged in the pipe circuit to prevent any undue increase or diminution of pressure.

There are, of course, many road vehicles at the Show, both steam and petrol driven, and it is scarcely necessary to do more than mention the names of Charles Burrell and Co., Aveling and Porter and Co., Wm. Allchin and Co., Wm. Foster and Co., Fodens, and Garretts, to indicate the type of the exhibits; but there was one thing which struck us very forcibly in connection with this side of our engineering industries, and that was the growing popularity of road transport. One firm alone told us of an order for one hundred six-wheelers which it had just booked, while others told us that their men were working "overtime" to keep pace with the business.

As usual on these occasions, we confine ourselves to the exhibits in the main hall, as those in the smaller rooms are not of such direct interest to engineers. For the same reason we do not describe the many agricultural implements shown. It should be mentioned that among the makers of this class of plant there are J. and F. Howard, Ltd., of Bedford, Martin's Cultivator Company, Ltd., of Stamford; George Stephenson and Sons, Ltd., of Newark-on-Trent; O. F. Stevens, of Wimborne; E. R. and F. Turner, Ltd., of Ipswich; and Samuelson and Co., Ltd., of Banbury. Ruston and Hornsby, Ltd., of Lincoln, show some agricultural machines besides the usual range of oil engines. Wallis and Steevens, Ltd., of Basingstoke are showing a light traction engine mounted on rubber tires.

In connection with the Show R. A. Lister and Co., Ltd., of Dursley, entertained a number of guests at the Hotel Metropole on December 11th, and subsequently invited them to see a variety "show." During the evening Mr. Frank Hodges made a most amusing speech, of a rather political nature; and Mr. A. W. Robins told something of his experiences in the foundry of the Dursley Company. The chair was, of course, taken by Mr. C. P. Lister, and Sir Frank Nelson made a short speech in proposing the toast of the "House of Lister."

Obituary.

MR. W. J. H. DIPLOCK.

THE death of Mr. W. J. H. Diplock, joint managing director of Erith's Engineering Company, Ltd., occurred on December 5th, at his home at Croydon. For a number of years before joining the firm of Erith's Engineering Company, Ltd., Mr. Diplock was a solicitor in practice on his own account. A man of wide interests, he possessed a special knowledge of patent and contract law, apart from a considerable acquaintance with engineering and other matters. His personality endeared him to a wide circle of friends, who will keenly feel his loss.

CAPTAIN C. J. JENKIN.

CAPTAIN C. J. JENKIN, of 91, Old Town-street, Plymouth, died suddenly on Wednesday, December 5th, while explaining a scheme for obtaining a water supply from Dartmoor to a joint conference, held at Salcombe, of the Salcombe and Kingsbridge Urban District Councils.

Captain Jenkin, prior to going to the West Country, was engineer to the Finchley Urban District Council. For a considerable period he had been engineer to the North Cornwall Water Board, and he was responsible for the extensions which were declared open by the Prince of Wales when the latter paid his last visit to the Duchy.

Captain Jenkin, who was formerly an officer in the Royal Engineers, had practised as a civil engineer at Plymouth for a number of years. He was a member of the Institution of Civil Engineers and of the Institution of Municipal and County Engineers, and a Licentiate of the Royal Society of British Architects.

SIXTY YEARS AGO.

NEITHER the congestion of traffic in London's streets nor the difficulty of devising a satisfactory system of regulating it is a modern problem. Sixty years ago, when all the vehicular traffic was of the horse-drawn variety and before even horse-drawn trams had come to add their bit to the complexity of the situation, the problem of how to deal with London's street traffic was in its way almost as acute as it is to-day, and means for its solution were as hard to find. From an article in our issue of December 11th, 1868, we learn that, giving evidence before a Select Committee of the House of Commons on the London City Traffic Regulation Bill, Mr. Knight, superintendent of the South-Eastern Railway, recommended the adoption for the regulation of street traffic of the system adopted on railways, namely, the use of semaphore arms by day and of green and red signal lights by night. Mr. Knight also urged that principal streets should be dealt with as main lines of railway and side streets as branch lines or junctions. Narrow side streets, he suggested, should have signals at each end to indicate that traffic was allowed to pass through them in one direction only—an early anticipation of our modern one-way traffic system. Mr. Knight's proposal concerning the use of traffic signals was given a practical trial. At the junction of Parliament-street with Great George-street and Bridge-street, Westminster, an experimental semaphore signal post was erected. The post illustrated in the issue referred to above was designed and supplied by Saxby and Farmer, railway signal engineers. It was a curiously ornate construction carrying three 4ft. semaphore arms at a height of 18ft. above the ground level and surmounted by a lantern which at night displayed a red or a green light, according to the positions of the arms. The semaphore was operated by means of a balanced crank in the base of the standard. The illuminant was gas and a small by-pass maintained the burners alight ready for turning up at night or at the onset of a fog. In the event of the trial station working successfully—and there was no reason, so we wrote, why it should not—a great and rapid extension of the system might be looked for. In our issue of May 4th this year our readers will find an account of a modern version of street traffic signal with which the Metropolitan Police have been experimenting. Sixty years have passed since the first signalling system was tried. It did not meet with a "great and rapid extension." To-day, as then, in spite of the revolutionary changes in the speed and nature of the traffic to be controlled, the police constable's arm dominates the situation at our busy crossings. We have, however, not been standing wholly still in the matter; we have provided that arm with a white sleevelet.

B.E.S.A. SPECIFICATIONS.

SAMPLING AND ANALYSIS OF COAL.

A MEETING of a representative Committee of the British Engineering Standards Association on the sampling and analysis of coal was held on November 29th last at the Institution of Civil Engineers, when reports from the various Sub-committees and Panels which had been studying the details of the problem during the past few months, were presented. Although Mr. Ridley Warham, the Chairman of the Sampling Committee, was not able to present any very definite report, the problem, complex as it is, is being fully explored with every prospect of ultimate success. In the meantime, certain tentative proposals for both chute and truck sampling have been put forward, and representative Panel Committees have been appointed in various districts to obtain experimental evidence regarding the practicability of these proposals, including the question of the minimum weight which should be specified for the gross sample. The Committee has urged the Panels engaged in this experimental work to expedite their work, in view of the basic importance of the results.

Mr. Clay, the Chairman of the Analysis Committee, was able to report that the Panels dealing with Moisture, Volatile Matter, Ash, Sulphur, Calorific Value, Agglutination, Phosphorus, and Arsenic, had all been working hard, and had made unexpectedly good progress, owing to the goodwill of the members, and also to the better understanding of the problem gained through dissemination of information regarding the various methods, particulars of which have been so unstintingly placed at the disposal of the Committee.

On the whole, the Technical Committee was well satisfied with the general progress so far made, and at the meeting which it is proposed to hold towards the end of February it is hoped that the Sub-committee and Panels will be in a position to submit definite proposals for some simple and economic national standard methods of sampling and analysis of coal, applicable to present-day trading conditions, both at home and abroad. The question of what, for want of a better term, may be called specialised tests, will also be dealt with, but they come within a somewhat different category, and the Technical Committee has thought it wise, in view of the urgency of the matter, to concentrate at first on endeavouring to obtain agreement as to the more simple tests to meet the day-to-day requirements of industry.

We are asked by the B.E.S.A. to call attention to a clerical error which occurred in a *précis* of the British standard specification and sections for bull head railway rails, No. 9, 1928, published on page 494 of our issue of November 2nd. In the sentence, "The maximum limits for phosphor and steel made by the basic Bessemer steel—higher carbon quality—have been raised," the word "basic" was typed in error for "acid." The error is self-evident, as it has previously been stated that one of the alterations made in the specification was the elimination of all reference to steel made by the basic Bessemer process.

REPORT OF THE WATER POLLUTION RESEARCH BOARD.

IN June, 1927, a Water Pollution Research Board was appointed by the Lords of the Committee of the Privy Council for Scientific and Industrial Research, with the following terms of reference:—

(1) To submit to the Committee . . . from time to time schemes for research on the prevention of the pollution of rivers and other sources of water supply by industrial effluents and sewage, and on any relevant matters affecting the purity of water supplies; and

(2) To supervise the execution of approved investigations.

The Board has issued its first annual report. It deals with the year ended June 30th, 1928, and it is published by H.M. Stationery Office, price 6d. net. The main report, which is signed by its chairman, Sir Robert Robertson, K.B.E., F.R.S., sets out the general activities of the Board during the first twelve months of its existence. There is, in addition, the first Annual Report of the Director of Water Pollution research, Dr. H. T. Calvert, which gives a brief summary of the researches carried out during the year under review, and indicates the lines on which further research is planned. Both of these reports, in addition to other matters, deal at some length with the question of effluents from beet sugar factories, a subject which at the present time is attracting a considerable amount of attention.

An 850 lb. Pressure Passenger Locomotive.

IN the issue of THE ENGINEER for March 9th we illustrated and gave some trial figures for a new 850 lb. high-pressure passenger locomotive, which was designed and built by the Swiss Locomotive and Machine Works of Winterthur. The tests referred to were of a comparative nature, and were made early in January of the present year, under the direct supervision of the Swiss Federal Railway authorities. The performance of the new high-pressure locomotive was compared under similar conditions with a conventional 180 lb. superheated steam locomotive having the same designed output. It was found that with the high-pressure locomotive there was a saving in the coal used of 35 to 40 per cent., calculated on a basis of drawbar horse-power, while as regards the water required an economy of 47 to 55 per cent. was clearly shown.

The performance of this new locomotive was referred to by Dr. Herbert Brown, of Winterthur, at the recent engineering conference held in conjunction with the Centenary Celebrations of the Institution of Civil Engineers, in the course of the discussion of the note upon "Latest Types of Steam and Internal Combustion Locomotives," which was introduced by Sir Henry Fowler and Mr. H. N. Gresley. This discussion was reported in THE ENGINEER for June 15th. At a meeting of the Institution of Locomotive Engineers, which was held towards the end of May last, Dr. Herbert Brown described in general outline the construction of the new locomotive with its novel type of welded boiler and the high-pressure geared uniflow engine. In what follows we are able to give some extracts from a revised copy of Dr. Brown's paper, and a detailed description of this interesting locomotive.

In outlining the principles underlying the design of the Winterthur high-pressure locomotive, Dr. Brown made reference to the fact that there has been no change since Stephenson's time in the characteristic features of the fire-box, blast-pipe and direct-acting engine, although a century of development had enabled steam locomotives of 4000 horse-power to be built for an unaltered width of track and loading gauge. Efforts had been made to increase the thermal efficiency by working at higher boiler pressures. The increase from 70 lb. to 140 lb. was followed by 200 lb. to 225 lb., and other economies had been introduced by compounding, superheating, and feed-water heating by means of exhaust steam. Compounding brought with it a saving in coal and water of 10 to 15 per cent., while the adoption of superheat gave another 10 to 15 per cent. saving, and the preheating of the feed-water a further 7 to 10 per cent. By such means the early coal consumptions had been brought down from 11 lb. to about 3·3 lb. per drawbar horse-power, but it was necessary to bear in mind that even the last named figure corresponds with a gross thermal efficiency of only 7 per cent. Further improvements on a locomotive of the Stephenson type were difficult to visualise, and new methods would have to be explored, of which two of the most promising were the widening of the pressure range and temperature by adopting either condensation or very high steam pressures, or probably both. Summarising recent American progress, Dr. Brown stated that in the United States higher steam pressures have been introduced, but only within the moderate limits of 350 lb. to 400 lb. per square inch, which might be more perhaps correctly termed medium pressures. The conventional design of locomotive had not been departed from save in the construction of the fire-box. Again, the retention of the riveted type of boiler would seem to impose a limit to the working pressures of between 400 lb. to 500 lb. per square inch.

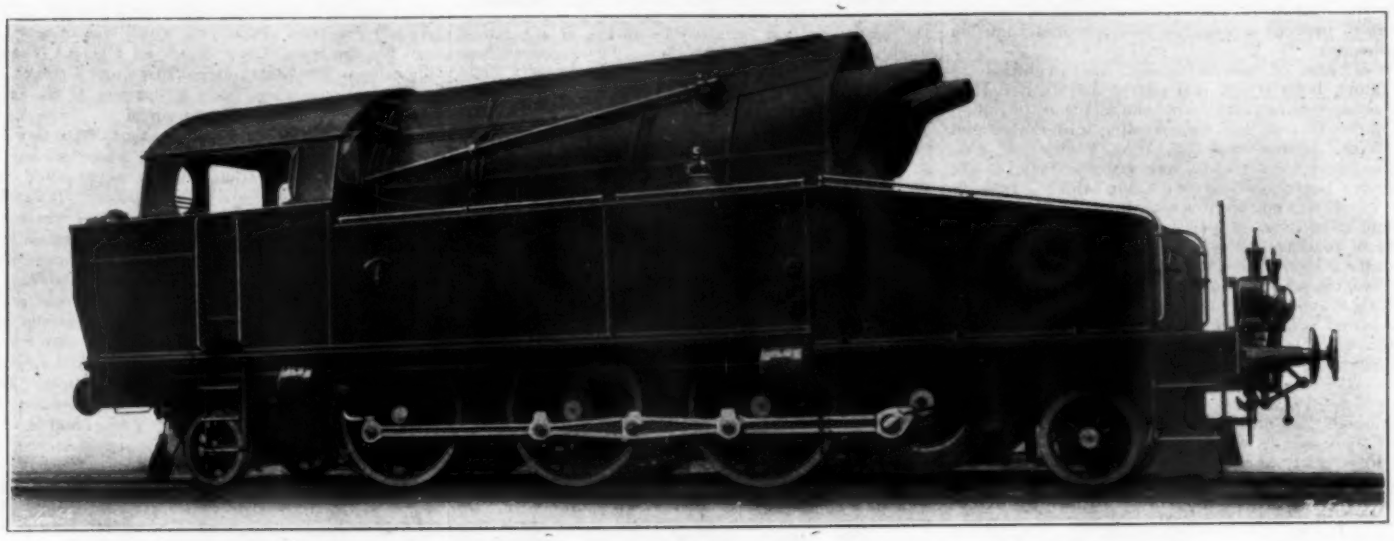
In Europe, on the other hand, higher steam pressures had been successfully employed, a notable instance being the two-pressure Schmidt-Henschel 880/200 lb. locomotive, of which a complete description, including road tests, was given in THE ENGINEER for January 20th last. It may be recalled that, in this locomotive, a standard unit was modified by introducing a special fire-box, in which the closed circuit high-pressure boiler was accommodated. Originally the high-pressure boiler consisted of six separate units, but these have now been modified, and the six elements have now been connected up to form one single unit.

The Winterthur High-pressure Locomotive.—Early in 1926 the Swiss Locomotive and Machine Works decided to build a high-pressure locomotive which would work at a maximum boiler pressure of 850 lb. per square inch, with an average working pressure of about 700 lb., thereby giving a certain working range between the average boiler pressure and the blowing-off pressure. Such a range allowed for a short period of overload and compensated for the limited water capacity of the boiler, which in the final design was only about half that of the conventional locomotive boiler. From the first, condensing was ruled out on account of the complications it would, necessarily, have introduced. Again, a high-speed uniflow engine with reduction gear was decided upon. With a geared locomotive it was possible to construct a standard engine, and, by using different gears, to meet the varied requirements of express, passenger or goods service. Again, with a geared locomotive the irregularity of drive, which in the ordinary steam locomotive may on occasion be as high as 25 per cent., at the driving wheels, is reduced by gearing to 8 or 10 per cent. By this means it is claimed that the adhesive weight of the locomotive is made better use of, so that, either the tractive effort may be increased for equal axle pressure, or the number of driving wheels reduced, with a corresponding decrease both in weight and first cost. It may also be pointed out that with a spring-borne engine the hammer blows which occur as a result of balancing the reciprocating parts by means of revolving counterweights are largely eliminated, so that with locomotives of bigger hauling power which are now required, would not require the permanent way to be strengthened.

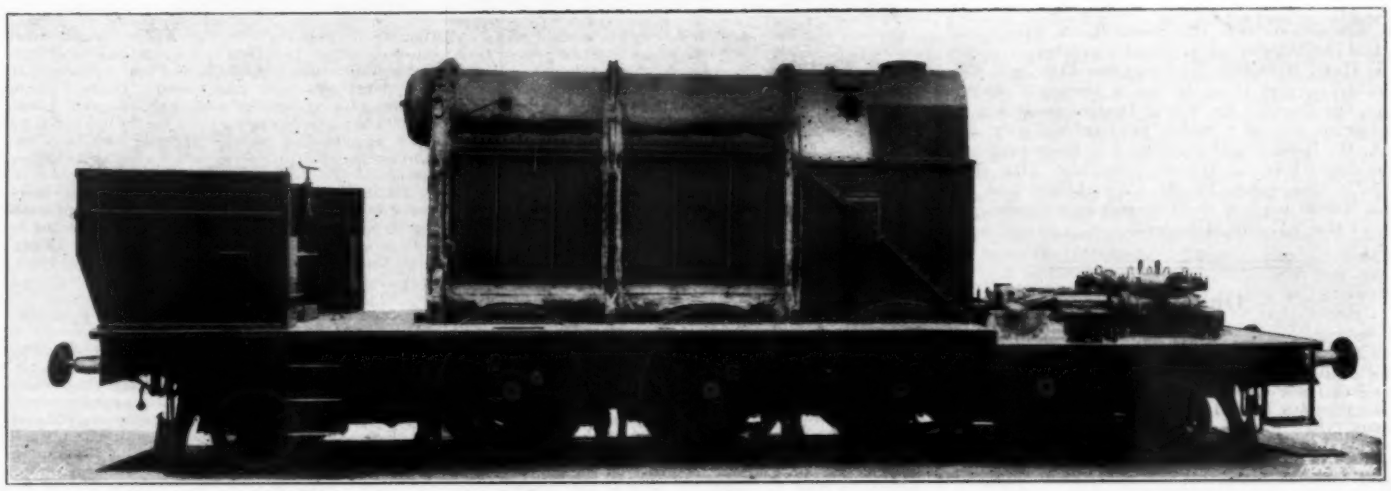
For reasons both of simplicity and reliability, a single expansion engine working on the uniflow principle with

850 LB. PRESSURE STEAM LOCOMOTIVE

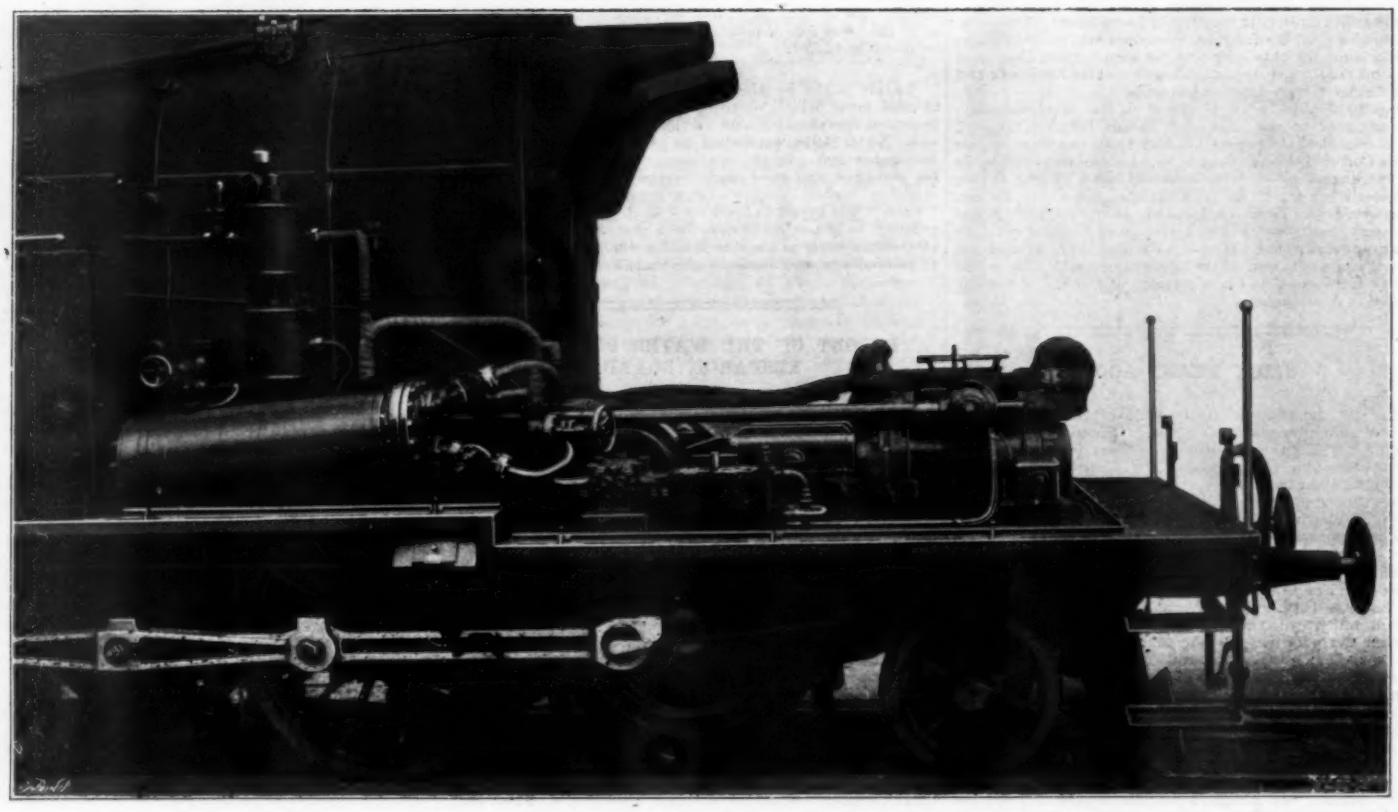
THE SWISS LOCOMOTIVE AND MACHINE WORKS, WINTERTHUR, ENGINEERS



GENERAL VIEW OF THE ENGINE



WATER-TUBE BOILER AND GEARED STEAM ENGINE ASSEMBLED



VIEW WITH FRONT HOOD REMOVED

poppet admission valves was decided upon. The boiler and engine were first constructed, and these were tested thoroughly for a year on the stationary test bed at the Swiss Locomotive Works. The results obtained were so favourable that the locomotive itself was then built and was able to run trials at the end of November, 1927.

The engravings—repoduced on page 656—show views of the locomotive in course of construction and also in its finished form. Fig. 1 is a self-explanatory diagrammatical general arrangement, giving the principal dimensions in millimetres and the axle weights.

Further detailed particulars in British units are given in the following table :—

Locomotive Dimensions.

Length over buffers	43ft. 1 $\frac{5}{16}$in.
Total wheel base	31ft. 2in.
Overall height	14ft. 0$\frac{1}{4}$in.
Overall width	9ft. 6 $\frac{5}{16}$in.

Boiler Particulars.

Boiler pressure	850 lb. per sq. in.
Heating surface of water tubes (fire side)	1050 sq. ft.
Diameter of water tubes	2$\frac{3}{4}$in. inside
Diameter of water tubes	2$\frac{3}{4}$in. outside
Length of top high-pressure drum	14ft. 9in.
Internal diameter top of high-pressure drum	2ft. 2in.
Length of bottom high-pressure drums	14ft. 8in.
Internal diameter of bottom high-pressure drums	7$\frac{7}{8}$in.
Water content at mean level	95 cub. ft.
Area of water surface	31·5 sq. ft.
Heating surface of superheater	215 sq. ft.
Diameter of superheater tubes	2in. inside
Diameter of superheater tubes	2$\frac{3}{4}$in. outside
Number of high-pressure superheater elements	Seven
Grate—	
Length	5ft. 4$\frac{1}{4}$in.
Width	2ft. 7$\frac{1}{2}$in.
Area	14·4 sq. ft.

Steam Engine Particulars.

Diameter of driving wheels	4ft. 8in.
Number of cylinders, single-stage expansion	Three
Diameter of cylinders	8$\frac{1}{2}$in.
Piston stroke	13$\frac{3}{4}$in.
Volume of cylinders	738 cub. in.
Clearance—	
Front	5 per cent.
Back	5 per cent.
Gear ratio	1 : 2·5
Maximum speed	50 m.p.h.
Weight empty	62·8 tons
Weight in working order	75·0 tons
Tank capacity	1320 Imp. galls.
Coal capacity	2·7 tons

As will be seen from the general arrangement drawing and the view reproduced in the centre of page 656, the water-tube boiler is placed directly on the frames, and it is furnished with a smoke-box and blast-pipe with a very short chimney at its forward end. It is somewhat shorter than that usually fitted to such a locomotive, and it allows the geared steam engine to be placed in front of the boiler without unduly increasing the wheel base. Another advantage of this arrangement is that the engine with the covering hood withdrawn—as shown in the lower view on page 656—is accessible from all sides. Power is transmitted through a jack shaft to the driving wheels by means of side rods. As the illustration show, the driving cab, water tanks and coal bunkers are arranged in the usual way.

The front hood covering the engine protects it against dust and dirt, and reduces the loss of heat due to radiation. At the same time it allows convenient access to the smoke-box and the front air inlet flues. The working principle of the new locomotive is clearly illustrated in Fig. 2, and details of the boiler construction are shown in Figs. 3 to 5. It will be seen from Figs. 2 and 3 that the combustion chamber of the boiler is closed in by the tube elements, and is fitted with a normal type of fire-grate, the dimensions of which are given in the above table. The heated gases pass through the water wall past the short stay tubes and reach the superheater and the feed-water preheater, which are accommodated in the boiler flue in front of the fire-box. There is an air preheater arranged in the smoke-box, and the products of combustion, having given up most of their heat, are expelled by the action of the blast-pipe, which intensifies combustion in the ordinary manner. The air which is required for combustion is taken in through two openings, arranged in the front wall of the smoke-box, which are protected by two cowls. It passes through the preheater and is carried by means of a duct to the underside of the grate.

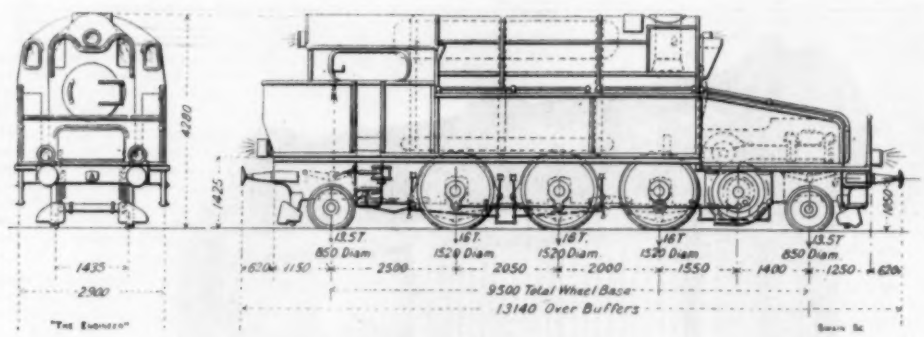
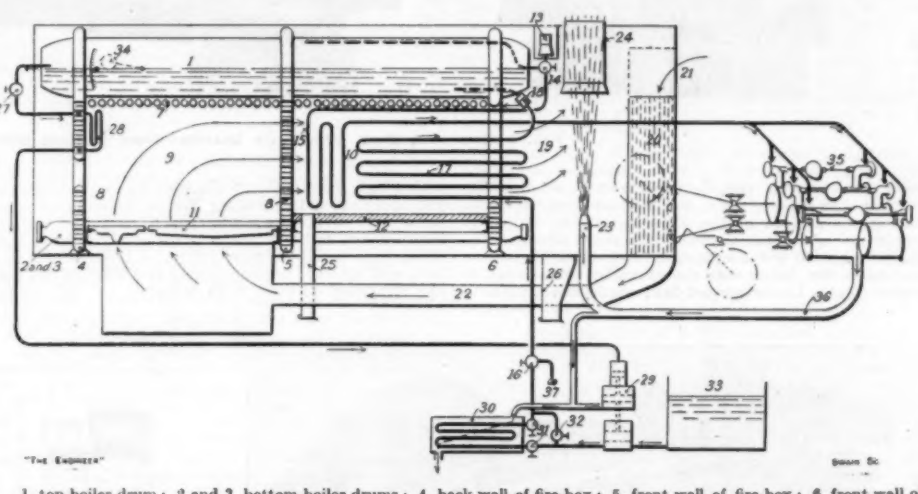
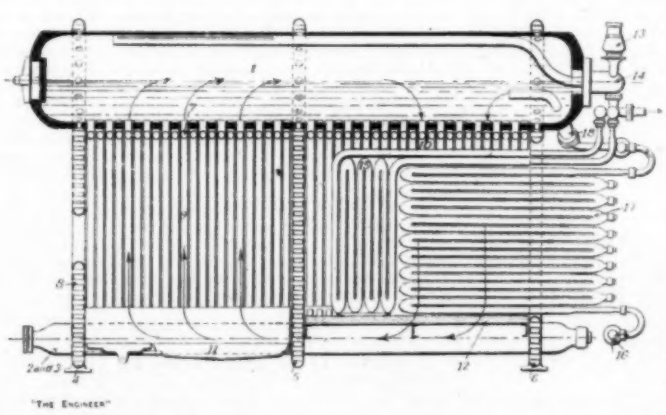


FIG. 1—GENERAL ARRANGEMENT OF THE LOCOMOTIVE



1, top boiler drum ; 2 and 3, bottom boiler drums ; 4, back wall of fire-box ; 5, front wall of fire-box ; 6, front wall of boiler ; 7, tube elements ; 8, stay tubes ; 9, fire-box ; 10, superheater and pre-heater chamber ; 11, fire-grate ; 12, refractory floor ; 13, safety valve ; 14, regulator ; 15, superheater ; 16, clack-box ; 17, feed water pre-heater ; 18, check valve ; 19, smoke-box ; 20, air pre-heater ; 21, intake openings of air pre-heater ; 22, air duct ; 23, blast pipe ; 24, chimney ; 25 and 26, cleaning shafts ; 27, stop valve for auxiliary steam supply ; 28, superheater for feed pump ; 29, feed pump ; 30, exhaust steam pre-heater ; 31, stop valve (normally open) ; 32, stop valve (normally shut) ; 33, water tank ; 34, water level float ; 35, steam engine ; 36, exhaust pipe ; 37, filling connection.

FIG. 2—850 LB. HIGH-PRESSURE LOCOMOTIVE—SCHEME OF WORKING PRINCIPLE



1, top boiler drum ; 2 and 3, bottom boiler drums ; 4, fire-box back wall ; 5, fire-box front wall ; 6, front wall of boiler ; 7, tube elements ; 8, stay tubes; 9, fire-box ; 10, superheater and pre-heater chamber ; 11, fire-grate ; 12, refractory floor ; 13, safety valve ; 14, regulator ; 15, superheater ; 16, clack-box ; 17, feed water pre-heater ; 18, check valve.

FIG. 3—850 LB. HIGH-PRESSURE LOCOMOTIVE BOILER—LONGITUDINAL AND CROSS SECTIONS

Steam is taken from the regulator, on which two safety valves are fitted, and passes through the superheater to the engine. The exhaust steam is led directly to the blast-pipe, but there is a branch connection to an exhaust steam preheater for the feed-water. A supply of auxiliary steam from the cab is taken for the feed pump, and this is superheated in a separate coil. The feed pump, which is clearly shown in the lower view on page 656, is of the high-pressure compound type, and its duty is to lift the water from the feed tank and force it through the feed heaters. The first is heated by the exhaust steam from the feed pump and by a part of the steam from the engine cylinders.

The feed-water is thus heated up to about 175 deg. to 195 deg. Fah. before it enters the main feed heater within the boiler itself, in which it is raised to boiling point before it passes through the check valve into the top boiler drum.

The arrangement of the various heating elements may be noted. The generating elements, the superheater, feed-water heater and air heater are placed in series, so that the heat from the gases is fully utilised, and only small surfaces are required, while a high degree of efficiency is attained. An important feature of the system is that there is no incrustation or scaling in the steam generating elements themselves, any action of this kind taking place in the exhaust steam and main feed-water heaters, which are so designed that they can be conveniently inspected and scaled.

Boiler Design and Construction.—The drawing reproduced in Fig. 3 and the views shown in Fig. 5 clearly explain the boiler design and construction. The large diameter top drum acts as a steam accumulator, and it is connected with the two smaller bottom drums by means of the tube elements shown in thick lines in the right-hand view of Fig. 3. A side view of these elements is given in Fig. 5. The drums are also interconnected by the water space walls, which are made of flanging quality steel connected by short stay tubes. The section through one of the tops of the water space walls, reproduced in Fig. 4, illustrates the method of welding the walls to the drums, and the "Hohn" type of strengthening straps which are fitted. When the whole boiler is assembled and welded—as shown in Fig. 5—it forms a very stiff structure, which, it is claimed, is particularly well adapted for locomotive work. Before the actual boiler was built each part was tested separately and a series of boiler and heater elements were subjected to very high water and steam pressures, with rapid changes of temperature, without showing any defects as previously mentioned; both the superheater and the feed-water pre-heaters are built in such a way that they can easily be dismantled into simple pipe units for thorough inspection. The centre view on page 656 shows the boiler with the lagging and asbestos coverings ready for completion.

The High-pressure Steam Engine.—The steam engine, which we illustrate in Figs. 6 and 7, works on the double-acting uniflow principle, and its principal dimensions are given in the previous table. The pistons are not fitted with tail rods, and there is therefore only one stuffing-box.

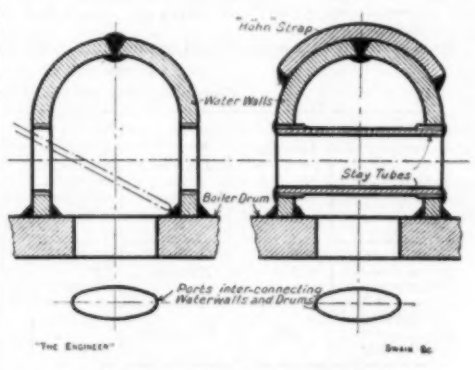


FIG. 4.—WELDED WATERWALLS

It is constructed of metal segments pressed lightly on to the piston-rod by means of springs. These stuffing-boxes may be conveniently adjusted from the crosshead side of the engine.

As will be seen from Fig. 6, the separate cylinders are bolted on to a flange on the crank case, which is placed between the frame plates and acts as an effective cross stay. A three-cylinder arrangement was chosen as giving the minimum number of cylinders, and at the same time a relatively simple distribution gear without having to sacrifice uniformity in torque and ease of starting. The valves are of the single seated poppet type, and, as shown in Fig. 7, they are operated mechanically by stepped

ahead and reverse cams arranged on a sliding cam shaft. There are six cams for each direction of running, and the cam shaft is driven from the crank shaft through spiral bevel gearing.

Bench and Road Trials.—Extensive bench trials were run with the engine arranged on a special stationary test bed; and the boiler and engine were thoroughly tested over a total running period of 350 hours. At first the superheat was a little high, but that was remedied by reducing the surface of the superheater. In the early trials it was also necessary to make some alteration in order to regulate the combustion, but when they have been made, the boiler was shown to be satisfactory in every respect. Under normal load conditions a total of 8500 lb. of steam per hour—which figure does not include the steam required for the feed pump—were produced, which corresponds to an evaporative factor of 8 and a production of nearly 600 lb. of steam per square foot of grate surface per hour.

Some of the actual pressure and temperature readings may be given. With an initial feed temperature of 70 deg. Fah. the water was raised to 190 deg. Fah. in the exhaust steam preheater, and further to 450 deg. Fah. in the main preheater within the boiler. The feed thus entered the top drum at a temperature of 50 to 70 deg. Fah. below the boiling point. The feed heating was, therefore, practically complete, whilst the range of superheat from 720 to 780 deg. Fah. according to the load was higher than that used in conventional locomotives.

In the bench trial the steam engine was tested under load, being run for 8½ hours several times in order that reliable consumption figures could be obtained. The indicator diagrams were not unlike those of a Diesel engine with a high compression and a strongly marked admission. The stepped cam operating the inlet valve gear can be set on one of six positions. Positions 1 to 5 are those for running, and position 6 is for starting only, with a boiler pressure of between 700 lb. and 800 lb. per square inch, and with the engine running at a speed of 550 r.p.m., the following outputs were recorded by the brake:—Position 1, 470 B.H.P.; 2, 800 B.H.P.; 3, 1000 B.H.P.; 4, 1200 B.H.P., which is a very good performance for an engine weighing, with all its accessories, only 4·81 tons.

The average steam consumption was 13·2 lb. per B.H.P. hour, corresponding to 1·75 lb. of coal per B.H.P. hour.

After the tests had been made the whole plant was carefully examined, and no solid scale was found in the boiler. A fine mud had collected in the lower high-pressure drums, which was easily washed off.

The first road tests were carried out in November, 1927, and the engine was shown to be very smooth on the road and easily started. Only 330 lb. of coal were necessary for lighting up compared with double the amount necessary for a conventional locomotive of equivalent output. The boiler was steamed within 1¼ hours of lighting up. Comparative road tests were made in January with a conventional 170 lb. pressure twin-cylinder superheated locomotive of the B ¾ type No. 1341, belonging to the Swiss Federal Railways, of equal output and under similar conditions as regards train load, express trains of 250 tons to 300 tons being hauled. This locomotive had a grate area of 23·7 square feet, compared with the 14·3 square feet grate of the high-pressure locomotive. The results of these trials were given in The Engineer of March 9th.

Further comparative trials were carried out from June 12th to the 19th, with the same conventional superheated steam locomotive, in order that a comparison might be established between the performance of such a locomotive and the high-pressure locomotive, under the different conditions of express, passenger and goods service with the heavier train loads given below. The trials were carried out with the official dynamometer car and coal briquettes having a mean calorific value of 13,500 B.Th.U.'s per lb. were employed throughout. The water and coal consumptions were determined in the presence of the officials of the Swiss Federal Railways, and the chief mechanical engineer has certified the records given in the accompanying table.

These further trials fully bear out the results of the earlier trials, and we learn that the locomotive after these trials was in continuous service for over two months, doing about 200 miles per day in the Winterthur district. Towards the end of October the locomotive was overhauled and has recently resumed regular service.

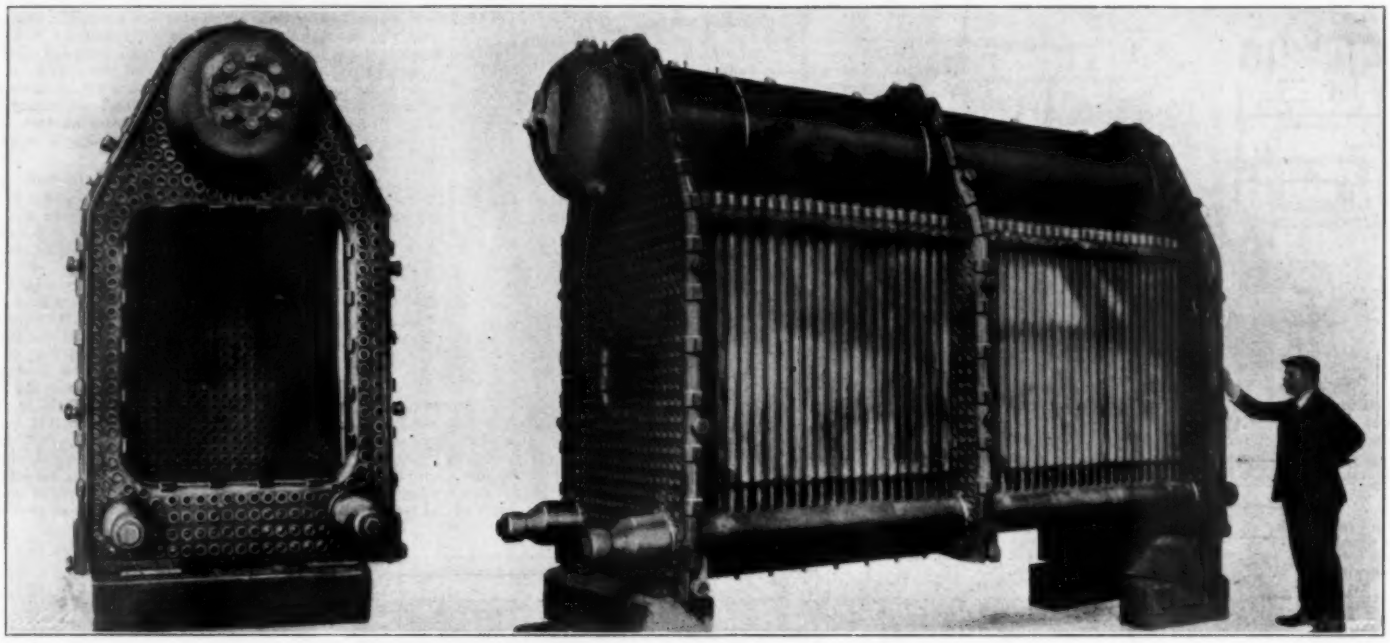


Fig. 5—End and Side Views of Water-Tube Boiler Before Mounting

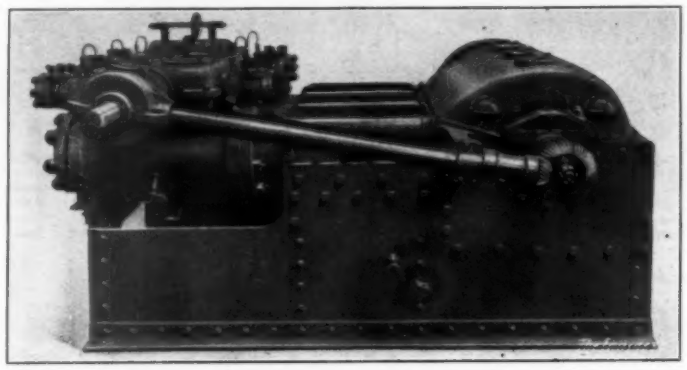


Fig. 6—Geared Uniflow Steam Engine

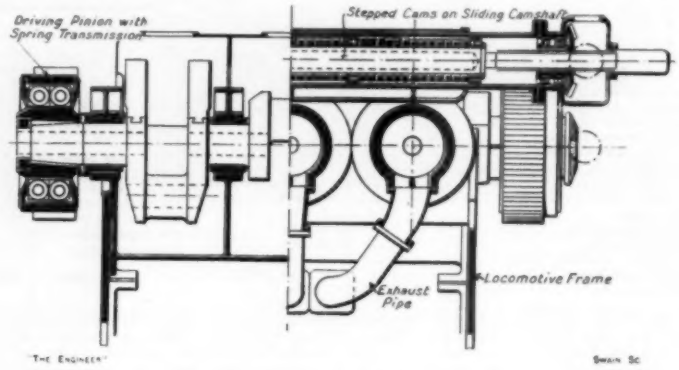


Fig. 7—Sections Through Engine

Comparative Test Records of Low and High Pressure Locomotives.

Section.	Load in tons, excluding locomotive.	Type of train.	Locomotive boiler pressure, lb. per sq. in.	Coal consumption.		Water consumption.		Percentage savings, high pressure against low pressure.	
				Lb. total.	Lb. per B.H.P. hr.	Lb. total.	Lb. per B.H.P. hr.	Coal, per cent.	Water, per cent.
Winterthur-Romanshorn-Winterthur	350	Express	170	2760	4·1	23,600	3·50	35·5	51·0
			850	1890	2·65	12,300	1·72		
Winterthur-Romanshorn-Winterthur	350	Passenger	170	3740	3·64	31,700	3·08	30·5	36·0
			850	2660	2·50	20,500	1·97		
Winterthur-Stein Sackingen-Winterthur	445	Direct goods	170	3410	4·08	30,600	3·67	25·5	38·3
			850	2460	3·04	18,500	2·26		
Winterthur-St. Gallen-Winterthur	300	Express	170	2590	4·08	23,100	3·63	38·4	42·5
			850	1730	2·51	14,500	2·09		

According to the annual report for 1927 of Colonel Sir John Pringle, 26·5 per cent. of the 200 fatal "movement" accidents were due to misadventure or accidental causes; 62 per cent. to want of caution by the deceased; 7 per cent. to want of caution or to breach of rules by a fellow servant; and 4·5 per cent. to causes for which the man was not responsible. Of the total of 3367 fatal and non-fatal movement accidents 386 were inquired into by the Assistant Inspecting Officers and the Sub-Inspectors, and it was difficult to assign more than 111, or 3·3 per cent., to directly preventable causes. Of these, 12 were ascribed to defective turntables, capstans or capstan ropes, 19 to defective brakes on wagons, 14 to insufficient clearance between vehicles and structures, 20 to dangerous systems of working, 15 to defective engine equipment, 9 to ground obstructions at stations and in sidings, 5 to defective permanent way, and 5 to failures of coupling poles, brake sticks, and similar equipment.

Railway Matters.

THE London and North-Eastern has opened a traffic control office at Lincoln, which is in telephonic communication with all the stations, sidings, and junctions in the Cambridge-Doncaster-Sheffield area.

MANY concessions are being made by the railway companies as from January 1st. The item that will probably be of most general interest is that the half fare for children will be raised from under twelve years of age to under fourteen. Traders are to benefit by the issue of traders' tickets at rates that were operative before the "appointed day," January 1st last.

IT is announced that a new organisation has been formed under the title of the British Motor Coach Service Association. The Association hopes eventually to organise a co-ordinated system of road transport, with stations all over Great Britain, at which tickets will be issued for travel to any part, so that it may be as easy to book for a journey by motor coach as by railway.

IT is essential, if guards are to obey their rules as to watching the signals, that their vans and brake compartments should have a look-out in the side. The new electrically operated stock on the Southern Railway has, however, been built to the widest possible dimensions and there is no room for the look-out. That difficulty has now been met by the provision in some brake compartments of a periscope.

ONE of the omnibus services which have been taken over by the railways is that between Rochdale and Halifax over Blackstone Edge—1270ft. above sea level. The railway goes through Todmorden and follows the river as far as Sowerby Bridge by a much longer route. For many years before the London and North-Western and the Lancashire and Yorkshire came to an agreement in 1906 there was a scheme for extending a branch line from Sowerby Bridge to Rishworth and Oldham, which would have covered the area now served by omnibuses.

WHEN Lieut.-Colonel Mount held his inquiry on October 30th and 31st, into the Dinwoodie fatal collision of the 25th *idem*, the evidence of the two signalmen concerned was given in private. It was, however, stated in public by the guard of the express and the stationmaster at Dinwoodie that the signalman there said that the goods train had been "cleared" and showed his train register in support of that statement. A sequel to the evidence given in private is that the other signlaman—the man at Wamphray—has now been arrested, but is released on bail.

THE Metropolitan Railway is seeking powers to widen its line from Wembley Park to Harrow. In addition to the two lines between Finchley-road and Wembley used by the London and North-Eastern trains, the Metropolitan has four lines between the same points, and when this proposed work is carried out that will be the case up to Harrow. It is also proposed to widen the tunnels at Swiss Cottage, Marlborough-road, Baker-street, Great Portland-street, Euston-square, and King's Cross stations, so that the platforms may be lengthened and longer trains run.

SUBSTANTIAL increases in the earnings of the Canadian National Railways are shown in an official statement covering the first ten months of the year. The gross earnings amounted to 226,472,575 dollars, as compared with 202,807,307 dollars for the corresponding period of 1927, an increase of 23,665,257 dollars, or nearly 11·67 per cent. The working expenses amounted to 180,062,454 dollars, as against 168,220,352 dollars, an increase of 11,842,102 dollars, or nearly 7·04 per cent. The net earnings totalled 46,410,110 dollars, which compared with 34,586,955 dollars, an increase of 11,823,155 dollars, or 34·18 per cent. As a result the operation ratio was reduced from 82·95 per cent. to 79·51 per cent.

THE driver of the mail train concerned in the Charfield disaster of October 13th appeared before the local police-court on a charge of manslaughter, on November 20th, 29th and 30th, when he was defended by Sir Henry Curtis Bennett, K.C. The driver maintained, as at the Ministry of Transport inquiry, that the distant signal was "off," and was corroborated therein by his fireman. The signalman at Charfield admitted that when the driver said to him after the collision "What is the meaning of this; your distant was 'off?'" he spoke as if he meant what he said, and agreed with Sir Henry Curtis Bennett that it was not a "try-on." On Friday, the 30th, after the bench had retired for only a few minutes, the Chairman announced that the magistrates were unanimously of opinion that the charge should be dismissed.

A VERY salutary rule in the standard book of rules and regulations for signalmen is No. 40, clause (*a*), of which provides that when a starting signal is at "danger" the home signal for an approaching train must not be lowered until the train has been brought quite, or nearly, to a stand. According to the report by Colonel Trench on the fatal collision of July 29th at Midland Junction, Miles Platting, Manchester, a breach of that rule by the signalman at Ancoats Junction contributed to that accident, in which two guards lost their lives. A passenger train stood on the Ancoats curve whilst its engines were being exchanged, and whilst the section between Ancoats Junction and Midland Junction was thus occupied the signalman at the former box was "offered" a light engine. He accepted it and, the section being occupied, kept his home signal at "danger," but subsequently lowered the signal for the engine to draw forward to the starting signal. According to Colonel Trench, "the home signal was pulled off too soon to give him (the driver of the light engine) a proper indication of the position in this respect." A sharp shower of rain came on after he had passed the home signal and, as the engine was running tender first, the man took his overcoat off a hook and apparently lost sight of the starting signal at "danger." Moreover, he saw, ahead of him, the home signal at Midland Junction at "clear." That indication was for the passenger train, but he took it as his and went ahead, with the serious results named above. The report concludes that the accident was one of those that would have been prevented by a system of automatic train control.

Notes and Memoranda.

A SWEDISH mining engineer, M. Ivar Setterberg, is reported to have invented a method of manufacturing porous light and heat-insulating firebricks similar to the so-called gas concrete in their qualities. By his method of production the weight of the bricks is said to be reduced to half that of ordinary firebricks, while their heat-insulating capacity is three times as great. The manufacture of the new bricks has already been begun at two Swedish works.

A WIRELESS beacon installation built at Start Point by Marconi's Wireless Telegraph Company, Ltd., for the Corporation of Trinity House has just been completed. This type of station transmits a special signal, on an exclusive wavelength of 1000 m., for the benefit of ships equipped with wireless direction finders, and the Start Point installation is the seventh of its kind now established round the British coasts. The transmitter has a power of 500 W, and the whole equipment is automatically controlled by a master clock for transmitting groups of interrupted continuous wave (I.C.W.) signals at pre-arranged intervals. The call sign of the Start Point station is GSM and accurate direction-finding bearings may be expected up to about 100 nautical miles under normal atmospheric conditions.

SELECTIVE network protection for long and interconnected transmission systems aims at the localising of faults with a minimum of disturbance to the sound parts of the system. This requires the response of relays and subsequent opening of breakers strictly confined to the source of fault. A new design of such a selective relay is described in the *Brown-Boveri Review*. It is claimed to fulfil the above requirements with a hitherto unattained accuracy and precision. It consists of a mechanical combination of three instruments—an impedance relay of the electro-magnetic type, a spring-actuated time element, and a cross-coil ohmeter, controlling automatically the tripping time. A mechanical cam connection is provided between the relay and the ohmeter. Among the features of this new instrument may be mentioned instantaneous resetting, selective time up to 5 seconds, 63-watts energy consumption, high sensitiveness to current reversal, insensitiveness to current variations of up to twenty times rated current. Practical experiences are quoted from a number of installations and tests.

AT a recent informal meeting of the Institution of Electrical Engineers, Mr. E. S. Ritter opened a discussion on "Picture Telegraphy," a title more comprehensive and accurate than "Photo-telegraphy," which, he said, was now an ordinary commercial process. Lantern slides illustrated the different forms of apparatus, their internal mechanism, and diagrams of connections; the Bell, Belin, Siemens-Carolus, Bart-Lane and Marconi systems were some of those described and compared. Alternating current was generally used, as it was more easily transmitted over a telephone line, its frequency being chosen to suit the line characteristics. At present in all picture transmission some sharpness must be lost, and a photograph was reckoned to be critically sharp if the smallest dot did not exceed 5 mils in diameter. Mr. W. Cruickshank discussed the practical field for picture telegraphy, compared the speed of the Marconi system with that of the ordinary multiplex telegraph system, and pointed out that for sending symbols, diagrams, or special type, the picture telegraph was easily the best; it was being used in Japan and China for transmitting documents in the 4000, or so, native characters that had no alphabet.

IN a paper read to the Institution of Electrical Engineers by L. G. H. Larsfield, on November 22nd, the question of the standardisation of the electrical equipment of X-ray apparatus was discussed. The subjects included were induction coils, voltage transformers, filament heating transformers, rectification and switchgear, and control fittings. The Coolidge tube has now largely displaced the gas tube for X-ray work. In the former a hot cathode governs the tube current by supplying a steady stream of electrons, the impact of which upon the anode causes X-rays to be generated. Induction coils are now seldom used, having been displaced by transformers. In the author's opinion, however, for the highest voltage work there will in the future be a reversion to some improved type of induction coil. Of special interest was the description of a very small set—10in. by 7in. by 6in.—weighing only 26 lb., patented by Coolidge. The tube is only 4in. long, and operates at 56,000 volts and 10 micro-ampères. As the whole of the high-voltage system is enclosed in an earthed metal case, there is no danger of electric shock and no external electric field. Objects under examination can be brought very near to the tube. Other equipments which are used for Army requirements, such as examining the materials used in aeroplane construction, &c., were also described.

ALTHOUGH the origin of most coal mine explosions can be traced with reasonable certainty, there are instances on record where all the possible causes of ignition appear to have been absent. Having regard to the vivid flashes that sometimes accompany a fall of rock in a mine roadway, it has been suggested that the sparks or heat generated by the impact of rocks might be a possible cause of the ignition of fire-damp. In Safety in Mines Research Board Paper No. 46, entitled "The Ignition of Fire-damp by the Heat of Impact of Rocks," by M. J. Burgess and R. V. Wheeler—H.M. Stationery Office, 9d. net—experiments are described which were made to determine the ease with which fire-damp could be ignited by the sparks or heat produced through the impact of rocks. It was found that, under particular laboratory conditions, ignitions could be obtained comparatively easily. The cause of ignition would appear to be, not the sparks, which are so often produced in brilliant showers, but a heated area of the stationary rock where contact is made with the moving rock. It is possible, however, to ignite fire-damp by the comparatively large particles of fused rock which are sometimes thrown off as "sparks" by the heated area. It is concluded that in actual mining the conditions most likely to cause ignition would be when a large mass of rock falls some distance and glides along the sharp edge of another piece; or when a mass of falling roof causes the grinding of two surfaces against each other under great pressure.

Miscellanea.

DURING one week in October the total output of the Kailan Mining Administration's mines was 80,771 tons.

A PAPER and pulp mill is to be started at Port Melon, on Horse Sound, British Columbia, at a cost of 2,000,000 dollars.

A GLASS bottle manufacturing plant, to cost 250,000 dollars, is to be put up at New Westminster, British Columbia.

IT is announced that an office building which has just been started in Toronto will ultimately have thirty storeys and will be 670ft. high to the top of the central tower.

THE first radio-electric clock ordered by a railway company will be put into operation in the new passenger station of the Baltimore and Ohio Railroad in the Chanin Building, New York, which is to be opened shortly. The clock will control dials in other parts of the station.

NEW automatic telephone exchanges equipped with Swedish apparatus and material have recently been installed in Naples and Smyrna. The Naples exchange at present serves 8500 subscribers, and will have an ultimate capacity of 80,000 lines. The Smyrna automatic exchange will have an ultimate capacity of 2000 lines.

CONSTRUCTION work is proceeding at the Port of La Gaiba, in the Department of Santa Cruz, Bolivia. The port has been leased to a British colonisation corporation, and shipments of timber are expected to begin very soon. A contract has been signed for the construction of a railway from La Gaiba to Santo Corazon—120 kiloms.—which will carry freight to a point on the Rio Paraguay, which will open up an important section of rich but almost undeveloped country.

IN order to provide for the increasing demand, the Société Turque d'Electricité is about to extend its central station at Silighdar, Constantinople. A new battery of four high-pressure steam boilers and a 2700 kW turbo-generator are to be installed, and at the same time the low-pressure section of a 10,000-kW turbo-generator is to be converted to high-pressure. A 10,000-V transmission line is also being erected from the power station to the banks of the Bosphorus.

AT a meeting of the North American Committee on Fishery Investigation, held in Montreal on October 23rd, prominent consideration was given to the damage which might result to fisheries from the harnessing of the tides of the Bay of Fundy at St. Andrew's, New Brunswick. It was declared that the Dexter Cooper power project, which proposes to dam Passamaquoddy Bay, on the international coast, with an area of 135 square miles, threatens what is perhaps the most productive sardine herring fishery in the world.

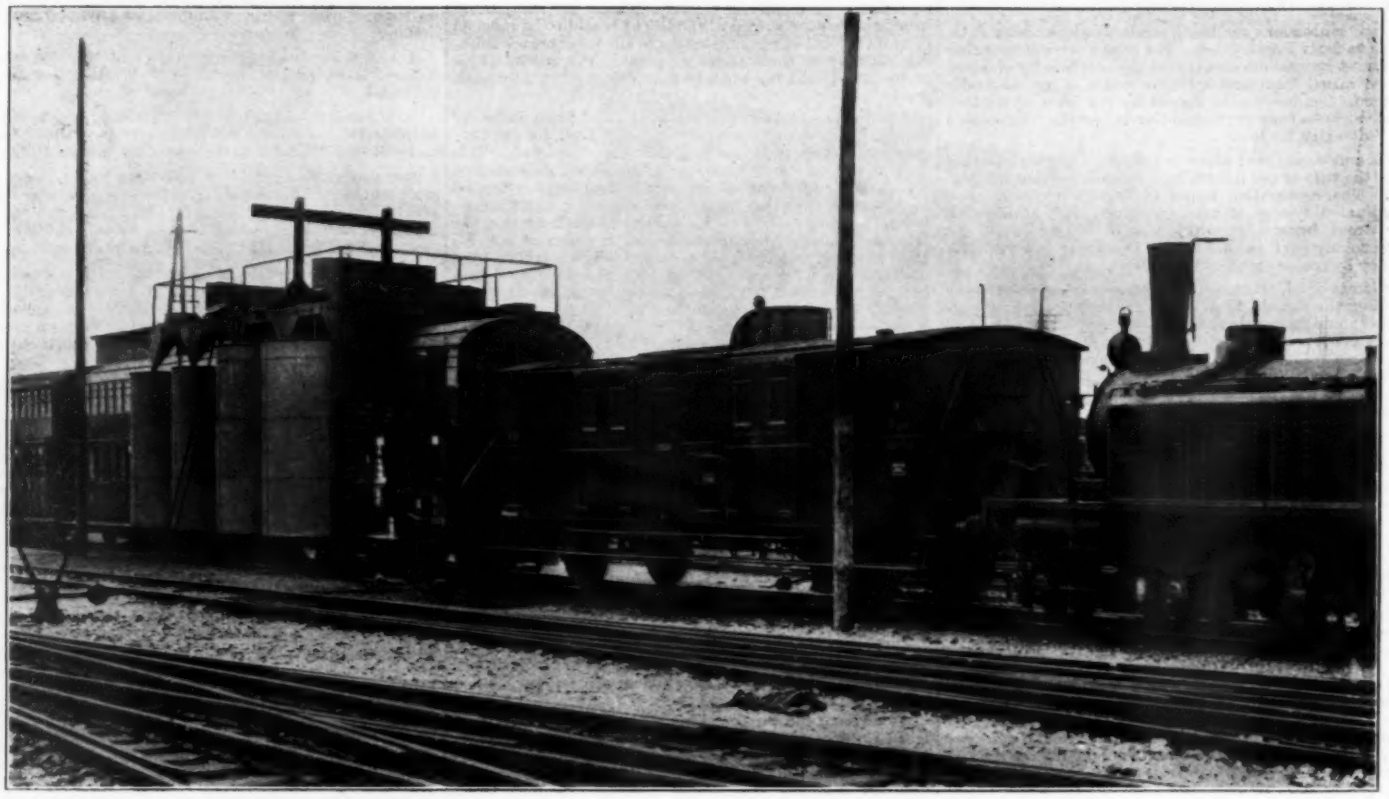
THE Brazilian Federal Government has authorised an expenditure not exceeding 15,000 contos (£375,000) on port works at San Luiz-de-Maranhao and Recifé (Pernambuco). At Recifé 200 m. of quays in 10 m. of water and 330 m. in shallow water will be constructed. Orders have been given for a cold-storage plant, endless belts for loading and unloading coal, electrically-operated cranes and other apparatus. At Victoria, the new port works will shortly be completed. The State of Espirito Santo has contracted for the dredging of this port, wharf extensions and three reinforced concrete warehouses. A bridge of six 65-m. spans is to be built connecting the mainland with Principé and Victoria Islands.

IT is reported that the Southern Railway Company's private branch automatic telephone exchange, installed some three years ago with a hundred Post Office public exchange lines, is already proving insufficient to deal with the increasing ramifications of railway traffic radiating from Waterloo Station, London. Plans are said to be under consideration for further extensions of the system, involving a possible expenditure of £100,000. More than 3000 calls an hour are dealt with during the peak periods, and the operators are capable of dealing with 150 calls per minute. Approximately 2000 stations are in direct touch with headquarters over the company's 850 private lines. From this telephone exchange are sent out each day Greenwich time signals to all stations. Some 59,000 public calls, made from the company's four kiosks at Waterloo, are dealt with monthly. Telegraph messages are handled, goods deliveries in all parts of the country are dealt with; general inquiries and questions as to times of trains, &c., are answered. The company has its own private telephone directory.

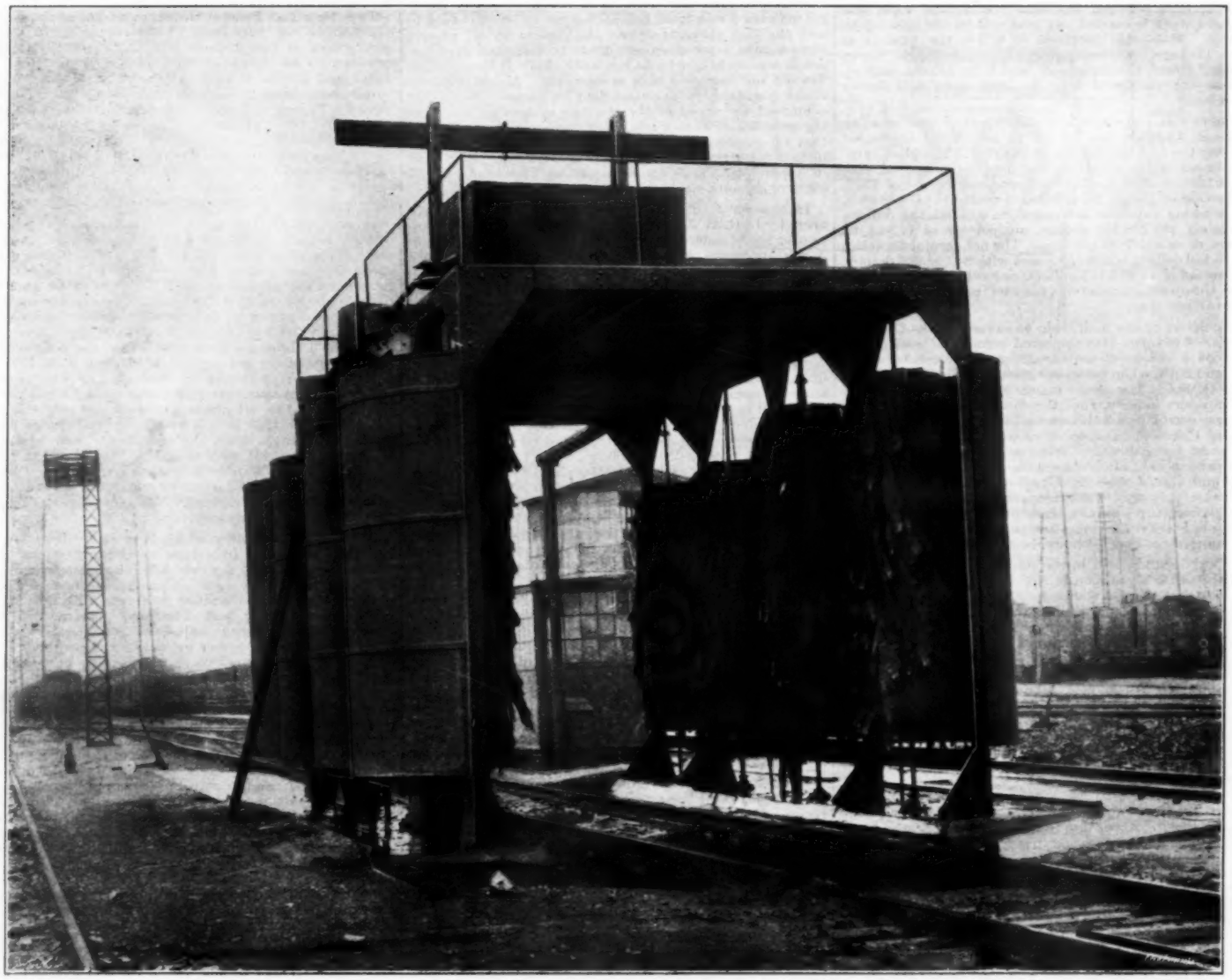
AMONG the machinery which is to be exhibited at the forthcoming British Industries Fair, Birmingham, there will be, according to a recent official announcement, the following items:—A new six-spindle drilling machine; dividing apparatus for milling machines, with new feature for quicker holding and releasing; electric resistance furnaces of new type; adjustable spindles which drill holes either close together or wide apart; rubber lining capable of resisting corrosive and erosive liquids up to 110 deg. Cent.; new tensile testing machine for rods, capacity 5000 lb.; improved welding rod; galvanising by electro-deposition, entirely new process; deep drawing device that converts any single-acting press into more than a double-acting press at will; outdoor condenser type bushing to comply with specification of Central Electricity Board; electric pyrometers with new systems of automatic alarms and control; concrete block-making machine; silent portable petrol-driven and electrically-driven air compressors; entirely new design of gas-tight and water-tight ironclad distribution boards; "built-in" electric motors, suitable for driving machine tools; special large size "drum" type separator, for dealing with foundry sand, shipyard refuse, borings, &c.; new portable blower for blowing dust out of electrical windings; new waterfall separator for extracting iron from pulverised fuel, foodstuffs, &c.; new magnetic rake; new developments of continuous carbonisation in vertical retorts for manufacture of town's gas; new portable machines for inoculating outdoor timber against fungi, rot and insects; high-speed crude oil engines; electric motor with reversing gear-box, which gives instantaneous stop or reverse with motor running continuously in one direction.

EASTERN RAILWAY OF FRANCE—PASSENGER TRAIN CLEANING MACHINE

(*For description see page 652*)



A TRAIN BEING WASHED



GENERAL VIEW OF THE WASHING MACHINE

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THE ENGINEER.

DECEMBER 14, 1928.

Overhead Power Lines.

IN a paper read at a recent meeting of the Institution of Electrical Engineers, Mr. W. B. Woodhouse describes some research work carried out by the British Electrical and Allied Research Association on the problems that arise in the construction and use of overh ad lines, work that has apparently demonstrated that poles conforming with the existing regulations are stronger than they need be to cope with the stresses to which they are subjected. Earlier work of this Association, notably in connection with buried cables, is said to have proved of great value to the electrical industry, if not to the community as a whole, and this new research relating to overhead transmission and distribution also appears worthy of no small amount of praise. When it is remembered that this country is to have very many miles of overhead power lines, and that it is desirable to carry out the work of constructing them as economically as possible, the desirability of making investigations that will assist engineers to reduce exp nse without detriment to reliability or safety is readily understood. A brief consideration of the matter showed that designers were badly in need of reliable working data, and that a comprehensive study of the various factors involved would in all probability prove of great assistance to those engaged in overhead line construction. It has been the custom to use red fir wood poles singly, or where greater strength was required, as compound pole structures, known as "A" or "H" poles made up of two equal poles bolted and braced together. As the usually accepted figures on which calculations of strength were based were open to question, it was thought desirable that the strength of these poles under ordinary conditions of use should be definitely ascertained.

The work which Mr. Woodhouse describes relates to the strength of single and compound poles as well as the intensity of wind pressures on wires and cables, such as those associated with overhead power lines and lattice structures for supporting them. The tests on wooden poles disclosed a fundamental weakness in the usual design of compound wooden pole, and led to the development of improved designs. Accurate figures were obtained of the rupturing strength of red fir poles. The wooden poles were tested under practical conditions and the information gained was supplemented by a series of tests on small scale models, which confirmed the claims made for the greatly increased strength of the new designs of compound poles. The tests of wind pressures were made on wires of various sizes, on cylindrical sections corresponding to those of wooden poles, and on angle bars, and a lattice framework. Definite values of the coefficient relating wind pressure with velocity have been recorded by these tests, and the figures should prove of considerable value to designers. Information was also obtained that enables designers to make proper allowance for wind pressures on wires and cylindrical poles of the sizes commonly employed for electric power lines. Finally, a series of experiments designed to determine the wind pressure on angle bars, indicated that the wind pressure on a fabricated frame may be estimated from the data obtained by tests on standard sections. Although the investigation covered a pretty wide field, there are other matters that call for attention, and further work is now in hand. The tests on the various types of poles as a whole brought out clearly the need for further knowledge of the behaviour of earth foundations, a matter that is now being studied by the Association. These tests were made with the poles set in the usual way, and kinematograph views shown at the meeting at which Mr. Woodhouse read his paper demonstrated that in every case the failure of the pole was preceded by a large displacement of the pole in the ground. The fact that the tests were carried out under practical conditions adds great weight to the paper, which will no doubt be studied with considerable interest by designers of overhead lines. Into the details of the tests on the strength of wooden poles we need not enter, but it may be mentioned that the improved poles, to which we have referred, have been devised by Mr. J. E. Rutter and Mr. E. B. Wedmore, the director of the British Electrical and Allied Industries Research Association. The Rutter compound pole consists of two poles side by side spaced a short distance apart by blocks of wood notched into them, so as to resist the shear stress and secured by through bolts, whilst foundation resistance to overturning is provided by cross bars. On the full scale tests of these poles the average observed strength was six times that of the single pole or more than three times that of the French type of pole, which consists of two poles closely bolted together. The Wedmore pole is similar to the Rutter pole, but the pole units are initially stressed by bending them, so that advantage may be taken of the greater strength of wood in tension than in compression. The spacing blocks are arranged so that the two poles are more widely spaced near the centre than at the ends, with the result that the poles are bowed and initial tension is thereby imposed on the two outer and compression on the two inner faces. Both the designs are claimed to result in a better utilisation of material than in the other types of compound poles, but the cost of construction should, of course, also be considered.

Taken as a whole, the research seems to have provided quite a lot of useful information, which it is to be hoped will be put to practical account. Savings in the cost of transmission and distribution are of vital importance, and the relatively small outlay which these investigations entail should not be begrudged. No one who has travelled on the Continent, and now in Ireland, can have failed to be impressed by the simplicity with which transmission schemes are carried out, a simplicity which is often in marked contrast with similar work to be seen in this country. There is no reason to suppose that greater danger is encountered when these simpler designs are used, and it is not improbable that the factors of personal safety insisted upon in this country are in excess of necessity. Since the cost of the distribution of electricity forms a very large item in its price to consumers, it is desirable in the interest of the development and extension of supplies that capital expenditure should be kept as low as possible. By the adoption of less elaborate poles than have hitherto been deemed essential, a not inappreciable saving in first cost may be effected.

Steel Sleepers.

IT is a remarkable, but happy, coincidence that a fortnight after the appearance of the leading article, entitled as above, in our issue of November

16th, the Southern Railway should have placed an order for 70,000 steel sleepers. Moreover, these, in contrast to the sleepers hitherto universally used, which can only be employed with a flat-bottom rail, are suitable for the bull-head rail and the jaws, which are pressed out as part of the steel plate, grip the rail by the web, as do the jaws of the chair used with the wooden sleeper. Designed by Mr. C. Peter Sandberg, some thousands of these steel sleepers were put in the quondam London and South-Western Portsmouth line, and, reporting on them to the Engineering Conference of June 5th in connection with the centenary of the Institution of Civil Engineers, Mr. Ellson, the chief engineer of the Southern Railway, said that they had been down for seven and a-half years, that they were in perfect condition still, and that the ganger said that they gave less trouble in maintenance than timber. The new sleepers have thus passed the trial stage, and in view of the present order it may be accepted with confidence that all fears as to the weakening of the jaw, difficulties as to packing, corrosion, lateral or longitudinal movement, the effect of weight or speed, &c., have been eliminated. Moreover, and of greater importance, the cost is about the same as that of wooden sleepers, and, judging by the experience with steel sleepers generally, the life is quite as great, if not greater.

It has to be admitted that there is one objection to steel sleepers, whether for flat-bottom or bull-head rails. It is that they would short circuit the electrical current between the rails when the track circuit was used in signalling. The remedy, then, where there is track circuit is the simple one of retaining the wood sleepers for the length necessary. That is the solution adopted in Germany. After all the objection will have little or no effect on the adoption of steel sleepers, as it is estimated that the total mileage protected by track circuit is less than 10 per cent. of the whole. Another difficulty is that the sleepers now ordered do not provide for the third rail used for a check rail on curves, at crossings, at level crossings and as guard rails on bridges. The same remedy applies there for the present, but it cannot pass the wit of engineers to design a modification to enable steel sleepers to carry a check rail—that has already been done with the flat-bottom rail. We may also see the insulating difficulty overcome, as it was in somewhat similar circumstances when track circuit, introduced into this country some thirty years ago, was rejected by engineers because of the Mansell wheel and because it could not be used at points. The great need for the security afforded by track circuit, however, set railwaymen thinking, and the Mansell wheels were bonded between the tire and the axle and the connecting-rods, stretcher bars and gauge plates for the operation of points were cut and insulating pieces inserted.

The action taken by the Southern and Great Western Railways is full of hope. It will provide work for the sorely tried steel maker, will support home industries and make us less dependent upon the decreasing—in quality as well as in quantity—timber supplies overseas. An interesting point which must not be overlooked is the possible adoption of the bull-head rail abroad if a suitable sleeper be available. British railways stand almost alone in the use of the bull-head rail; other countries prefer the flat-bottom, despite the less holding power of the screws or other fastenings, in contrast with the grip of the web of the bull-head rail by its chair—mainly because an additional unit—the chair—is necessary. In these new forms of sleepers there are only five units—the sleeper, two base plates, and two keys. It would be a remarkable thing if the adoption of steel sleepers generally led to a wide use of the bull-head rail abroad.

Literature.

Port Studies. By Brysson Cunningham, D.Sc., M. Inst. C.E., &c. Chapman and Hall, Ltd. London. 1928. 25s. net.

Under the title of "Port Studies," Dr. Brysson Cunningham has collected a series of articles on a few of the Atlantic Ports of North America, which appeared during last year in the pages of our contemporary *Engineering*, and has added to these some material of commercial and shipping interest from his contributions to the pages of the *Journal of Commerce*. We welcome this collection, for the papers Dr. Cunningham has selected and published in a convenient and permanent form serve as a useful supplement to his well-known books on "Harbour Construction" and "Dock Engineering," both of which gave but scant attention to the ports of North America and their characteristic methods of construction.

Most of the information in this volume is not, however, new matter, the descriptions of ports being largely based on the twenty or more volumes of the "Port Series" issued since 1921 under the direction of the Corps of Engineers, U.S. Army. These numerous and valuable publications are a veritable mine of information on American ports, and are on a scale which has never yet been approached in any other country. Descriptions of most of the port works referred to have also appeared in various American technical journals and "Proceedings." Many of these sources of information are, however, not usually accessible to the ordinary reader in this country, even among those whose work is closely connected with docks and harbours, and Dr. Cunningham's pages afford in a convenient form a fairly full and, we think, a trustworthy picture of modern port conditions in America—so far, at any rate, as the ports dealt with are typical of such conditions. The ports described are New York, Philadelphia, Baltimore, Boston, Montreal and Quebec. This list, of course, includes the chief Atlantic seaboard ports, though there are others on the same coast-line which, although of lesser importance, are perhaps of at least equal interest; and the many important harbours and port works of the States in the Gulf of Mexico and on the Pacific coast, as well as the western ports of Canada, are not included in Dr. Cunningham's survey.

On the Atlantic and Pacific coasts of North America, where the tidal range, except on the Bay of Fundy, is generally small and most of the larger ports are in situations possessing ample natural protection, accommodation is provided for shipping at long piers or jetties projecting from the shores of sea inlets or wide rivers into deep water. Many of these piers or "docks," as they are termed in New York, have berths upwards of 1000ft. in length with 30ft. to 45ft. depth at low water. Timber and reinforced concrete piles are commonly employed for these structures, but sometimes cylinders are used in place of piles for carrying the superstructure of a jetty and, in some ports, foundations of timber cribwork filled with rubble stone are still used to a considerable extent.

The harbour of New York is one of the most perfect natural havens in the world. It enjoys the advantages of ample water area and depth, shelter, good access, a small tidal range—no more than 5ft. at springs—and moderate tidal streams. The shore lines under the jurisdiction of the Port of New York Authority (constituted in 1921) have a combined length of over 480 miles, and, if the total berthing space of the piers be added, this figure is increased by about 150 miles. Excluding the Lower Bay, the sheltered water area within the jurisdiction of the Port Authority is approximately 150 square miles. In recent years the development of the trade of the port has led to the building of shipping piers on an extensive scale in positions remote from the old centre of trade in Manhattan Island. In this way Staten Island, Jersey City, Newark and the Long Island shores have become busy centres of maritime trade. More recently still, Jamaica Bay, a sheltered inlet on the south side of Long Island with access direct from the Lower Bay, has been developed as a new centre of port activity.

The North American Continent is well endowed with naturally sheltered harbours in positions where they serve the necessities of sea-borne trade. On the Atlantic coast of the United States, in addition to New York, deep water river harbours of ample width meet these needs at such ports as Philadelphia on the Delaware River, 88 nautical miles from the sea entrance to Delaware Bay, and Newport News and other places on the James River, Virginia. Deep land-locked bays or sea inlets provide the harbours of Baltimore, at the head of Chesapeake Bay; Portland (Maine) and Boston. Two of the most important Canadian ports, Montreal and Quebec, are situated on the magnificent river St. Lawrence, the former 550 m. from the Gulf of St. Lawrence, and Halifax in Nova Scotia is in a large land-locked, deep-water harbour free from ice all the year round.

In a final chapter the author sums up the impressions which he gained during a recent visit to the ports described by him, and makes an interesting comparison of the conditions which he found in them with the methods and practices generally adopted at ports in this country and on the Continent of Europe. This brief comparison and criticism is, we think, quite new, and is well worth reading by engineers and others engaged in port working and construction in this country. Much of the criticism of British methods which one hears is uninformed and leaves out of account the vast differences in conditions which affect port working in various countries. These differences are clearly stated, and their influence traced by the author. He writes:—". . . the situation is largely one of marked contrast rather than of simple comparison. The general conditions on the two Continents are so fundamentally different that, until the divergencies arising from inherent physical, geographical, commercial and economical causes are eliminated, anything of the nature of constructive and useful comparison will be difficult, if not impracticable."

The author draws interesting comparisons between the planning and working of American and British ports and, after dealing with the factors which are fundamental and geographical features, and therefore unalterable, he comes to a "consideration of those characteristics of American ports which are optional divergencies from the practice at British and many, perhaps most, European ports. Prominent among these are:—(1) The general adoption of open-piled wharves and piers instead of solid structures, such as concrete and masonry quays; and (2) the handling of cargo by means of cargo masts and ships' gear instead of by quay cranes." As to the former: "Where the question is not complicated by the necessity for dock formation, there are weighty and important arguments in favour of piled and framework piers, many indeed of which have of late years been constructed at English ports. It seems clear that this system of berthage will continue to extend, and that, in the absence of countervailing considerations, framework piers and jetties in open water and basins will supersede other forms of construction. Whether these piers and jetties should be of reinforced concrete or timber is a question which must be settled by the conditions prevailing at each particular port, but where the deterrent of the *teredo* menace is not an overruling consideration, there is much to be said for the adoption of timber piles for the substructure. They are lighter, easier to handle, more resilient, less liable to suffer seriously from abrasion, and when damaged, are more easily repairable than reinforced concrete piles, though, on the other hand, the admirable qualities of this material in durability, strength and resistance to fire must not be overlooked."

On the subject of cargo handling the author says:—"The essential difficulty of the situation at New York is the general absence on the majority of existing piers of a sufficient margin between the shed and the coping on which to install a crane track. The more modern piers have a wide enough margin, and, indeed, in some cases as . . . at the Port of Wilmington, Delaware, are equipped with movable cranes. But it would, generally speaking, be easier to adopt an English quay shed to burtoning operations than an American pier to receive a battery of quay cranes." We think, however, that, in connection with new construction, piers with open quay-side spaces and rail tracks, are becoming more common in the Atlantic ports generally, and several have been built since about the year 1918.

Some interesting modern coal-shipping plants in the United States ports are described by the author and, in comparing them with the equipment of British coal-shipping ports, it must always be remembered that in America railway freight cars are of much larger capacity than European, and coal cars carrying up to 120 tons are in use. By the use of these large cars and self-trimming loaders in conjunction with highly-developed arrangements for dumping cars and belt feeding, the rate of shipment of coal has been largely augmented. The Baltimore and Ohio Railway pier at Baltimore is double sided, 700ft. long, and has four main coal loading towers. Over 40,000 tons have been loaded at it in one day. The use of the American type of large coal-cars and mechanical trimming enables ships to be loaded with coal at some of the best equipped United States ports more rapidly than in British ports, where the time rate for a complete cargo does not often exceed 600 tons per hour, and is usually less on account of delays in trimming the coal between decks. The best American shipping plants have, in this respect, an advantage of at least 50 per cent. over the Tyne and South Wales ports.

The volume is well illustrated, it contains a good index but lacks a bibliography and references to authorities which would have been of assistance to readers who desire to pursue further their investigations of North American port problems.

The Viscosity of Liquids. By Emil Hatschеck, F.I.Ph., &c. London: G. Bell and Sons, Ltd. 1928. 15s. net.

The appearance of a number of books treating this subject within the last few years is a sign of the times. Up till lately the viscosity of oils and lubricants in general was about all that anybody took any interest in, whereas now the correct management of the whole artificial silk industry is bound up in the understanding of the viscosity of colloidal sols. The author of this book, who apparently specialises on colloids, has for this reason been forced to study the subject thoroughly, and he gives us in a comparatively short treatise an exceedingly complete picture of a highly complicated chapter of physics. From the nature of things his book is not elementary in the ordinary sense, although the mathematical part is simple enough. Still, in this case, the reader must be advanced enough to read just that part as essential and the experimental part as incidental. It is doubtful whether many chemists even to-day take sufficient interest in physics to benefit as they should by the author's work, and unfortunately the works' chemists have to measure viscosities as well as to attend to an infinite number of purely chemical matters. Judging from the preface, the author seems to have found the "most enterprising" of his students desirous of having such a book to refer to, and the reviewer can but hope that they will grasp the opportunity with zest, especially as the price of the opus is very moderate.

The author starts with a quotation *in extenso* of Newton's theorem on circular motion of liquids. This theorem is highly interesting from an historical point of view as introducing the method of dividing

the fluid in motion into zones or shells for applying the, at the time, novel differential calculus. The author shows that if Newton's deduction be true, then the force necessary for translating the rotary motion of the liquid from one cylindrical shell to another can be expressed as—

$$F = \eta A \frac{\delta v}{\delta z};$$

Where F = total force;
A = area of shell;
v = linear velocity of each point of the shell;
z = distance of shell from centre;
η = numerical constant (coefficient of viscosity).

Newton did not himself mention this condition, nor did he realise that $\frac{\delta v}{\delta z}$ does not necessarily vanish asymptotically, or, in fact, never does, except approximately within fairly narrow limits. The author goes into this question of the "velocity gradient," which, he says, "assumes considerable importance in anomalous liquids, such as the majority of colloidal solutions." Stoke's criticism of Newton's theorem seems to be a mistake in interpreting the word "impression" as force, instead of momentum, which the French to this day call "force vive," and the Germans "lebendige Kraft," the opposing factor being inertia or moment of inertia. From a pedagogical point of view, the footnote, page 2, might hence have been left out. Otherwise, the choice of Newton's theorem as primary argument is almost genial. Many things in the introductory chapter require an advanced knowledge of physics in order to be understood, *e.g.*, the deduction of the resistance to Coulomb's disc by fluid friction—page 7—from the logarithmic decrement of the amplitude of its oscillations. How many students of chemistry go far enough to come in contact with Gauss' fundamental work on that subject? Did Coulomb actually anticipate Gauss in using the logarithm of the damping fraction? Then follows Girard's interesting work, which clearly anticipates that of Poiseuille. If he had put D^4 instead of D^3 in his formula, it would have been identical with Poiseuille's by putting $C = \eta \cdot \frac{\pi g}{8}$, a practice which most of us indulge in. With the smaller capillary 1·8 mm. diameter and 200 mm. length, Girard's results would have come out practically correct with say, colza oil. As put by the author, Poiseuille's merit would seem to have been the choice of a capillary fine enough, and correcting the D^3 in Girard's formula to D^4. The merit of resolving the constant into its dimensional elements is stated to belong to Wiedemann and Hagenbach.

The descriptions of apparatus, &c., are very good, and in each case the application of the theory of capillary flow and oscillating or rotating cylinder, falling sphere, &c., is done in a, to all intents and purposes, faultless manner. As might be expected, the author has an apparatus of his own on the rotating and suspended cylinder principle. This apparatus is specially designed for testing colloidal sols. It consists of an outside rotating hollow cylinder, with a suspended concentric cylinder inside, the space between being filled with the liquid under test. The drag by the liquid is taken up by the suspension wire, and the deflection for various speeds is measured on the reflecting galvanometer principle. Whether this apparatus can be applied to "dope" of practical concentrations seems extremely doubtful to the reviewer, unless the dimensions are considerably modified.

When the author has gone so far, he discusses the influence of temperature and pressure on the viscosity of liquids in two chapters of absorbing interest. No physical property of matter is so markedly affected by temperature as viscosity, and this has enabled various investigators to test empirical formulæ and theories with greater certainty than usual; so rich is the material of recent date that the author has been forced to employ the greatest brevity of treatment compatible with lucidity. The same is the case with the chapter on variation with pressure, which includes the ultra-modern work by Bridgman, who determined viscosities under pressures up to 12,000 atmospheres. So far, only liquids of low viscosity have been examined, and it is a long step to the highly viscous cellulose solutions, which are now filtered under high pressure in the artificial silk processes. Still, the data found have some bearing at least on the latter, as showing how differently various liquids are affected. Bridgman's conclusion that "the largest pressure effects are for those substances with the largest molecules" is not a very comforting one.

The usual inclusion of viscosity amongst the additive properties of matter in the general scheme of physical chemistry is treated by the author as well as can be done, as solutions, in particular electrolytes, are rather unwilling to oblige. As these matters are of exclusively chemical nature, the reviewer must confine himself to this. The same thing can be said about the particular chapters on mixtures and colloids; they are well written, but merely applications of the principles so exhaustively treated in the first part of the book. Mr. Hatschek supplies on page 99 a remark by Gartenmeister on one of the many "constants," which is rather applicable to express the reviewer's own opinion, viz., it is "not a constant in the sense of a mathematician, but a physico-chemical constant." There are altogether too many of these in the special part, which the author has had to quote, and he is evidently well aware of the tentative nature of a great deal he has to tell to follow convention.

This book is one which it is rather difficult to put down, when once started. The material has been collected from a number of original papers with great care, and still the impression on the reader is that of a preconceived complete picture. Perhaps one might venture to suggest that not a few teachers might find it useful, as well as enterprising students.

Jane's Fighting Ships, 1928. Edited by OSCAR PARKES and F. E. MCMURTRIE. Sampson Low. 42s. net.

THE new edition of this famous annual appears at a moment when naval affairs are engaging public attention to an unusual degree. No other year book on this subject has quite the same fascination as "Fighting Ships." Tabulated data of the world's fleets are useful enough, but they do not, and cannot, make the same impression as actual photographs of the ships to which they relate. In the present volume there are more than 3000 camera studies and diagrams of men-of-war, ranging from the majestic battleships of the Great Powers down to the tiny gunboats of the obscurer maritime States. The motto of a famous German shipping company—"Mein Feld ist die Welt"—might well be applied to the annual founded by the late Fred T. Jane, and carried on with brilliant success, first by Mr. Maurice Prendergast, and then, in more recent years, by its present co-editors.

With capital ship construction arrested for the time being by the Washington Treaty, current naval shipbuilding is confined to lighter ships, of which the cruiser is very much to the fore. Dealing first with the British section, we observe with pleasure that plans of our latest cruisers have been included, obviously with official sanction. The details here presented are exceptionally interesting. The characteristics of the "Kent" class, as also of their immediate successors, the "Londons," are fairly well known. These ships are of the conventional 10,000-ton type standardised by Treaty. Excellent vessels of their kind, they labour under the drawbacks of heavy cost and extreme vulnerability. It is revealed, for example, that they carry no vertical armour and depend for protection to vital parts on a 3in. steel deck. Considering that in action with opponents of their own class they would be exposed to the fire of 8in. guns of the highest velocity, this exiguous protection cannot be deemed satisfactory. At the same time we readily admit the impossibility of working thick armour into a design which calls for propelling machinery of 90,000 S.H.P., a main armament of eight 8in. guns, with many smaller guns and torpedo tubes, and yet limits the displacement to 10,000 tons. The fault lies, not with our able constructors, but with the rules under which they have had to work. We have always doubted the value of these big, fragile cruisers as an investment for the British Empire, and we believe the problem will ultimately be solved by adopting a standard more in keeping with the "York" class, of 8400 tons, a plan of which is given for the first time. They appear to be admirable ships for trade protection, and with a broadside of six 8in. they need not shirk a duel with one of the larger Treaty cruisers, though an extra knot of speed would be an advantage. They are the first British cruisers in which provision is made in the design for the carriage of two seaplanes with launching gear.

Following the brilliant success of the "Amazon" and "Ambuscade," particulars of the new "A" class destroyers, now building, would have been of great interest, but they are not yet forthcoming. On the other hand, there is a good deal of new information about our latest aircraft carriers, submarines, sloops, and depôt ships. The Dominion Navies are beginning to make an impressive display. Australia has a small but thoroughly up-to-date fleet unit, Canada has acquired two destroyers, and is about to build two more, and New Zealand has announced her intention of maintaining two cruisers of the "York" class, in place of the less powerful vessels now on that station. A glance through the United States section should dispose of the legend that America is impotent on the seas. Here are great battleships, the most modern equal to anything afloat, the least modern being in process of thorough renovation at vast expense. Here are aircraft carriers matchless in size, speed, and powers, with hundreds of destroyers and submarines. Add to these the eighteen big cruisers built and building, with fifteen more in sight if Congress does what is expected of it, and little justification remains for the Jeremiads on naval defence which have been broadcast from Washington of late.

Although the Japanese Fleet is nowadays rarely in the limelight, its development continues to be systematic and purposeful. The editors have secured views of the latest ships, the appearance of which is entirely different from that of all other men-of-war. Japanese naval designers appear to have inherited the old French tradition of mountainous superstructure, though in justice to them it must be admitted that other countries, including our own, have adopted the trunked-in funnel system which they initiated. Moreover, despite their unconventional ideas about naval architecture, they appear to get astonishing results. On paper, at least, they have solved the age-old problem of inserting a quart measure into a pint pot. Ton for ton, their "Treaty" cruisers are easily first in all the main attributes of fighting power. After years of experiment, they have evolved destroyer and submarines types which compare more than favourably with the best foreign productions. It may not be generally realised that the Japanese submarine flotilla, so far as large ocean-going boats are concerned, is now the strongest in the world. The French Navy and the Italian are progressing on much the same lines. Both are turning out cruisers and destroyers for which almost fabulous qualities of speed and armament are claimed.

Some forty separate combatant navies are listed, illustrated, and described in this remarkable volume. We might almost say re-illustrated, for the number of new photographs, diagrams, and silhouettes is immense. "Twelve months ago"—we quote from the preface—"it appeared as though the difficulty of collecting sufficient fresh material might be felt in comparison with former years. Fortunately, the efforts of the editors have proved exceptionally fruitful, and the present edition will be found to contain matter of interest exceeding anything previously published." That is a statement we can heartily endorse, and no more need be said about a volume, the annual appearance of which is an event of capital importance to naval students all over the world.

The Geology of Petroleum and Natural Gas. By Professor ERNEST RAYMOND LILLEY. London: Chapman and Hall, Ltd. 1928. Price 30s. net.

THE geology of petroleum is a subject of very great importance and one which is attracting no little interest at the present moment. This work naturally challenges comparison with Mr. Stigand's book, "Outlines of the Occurrence and Geology of Petroleum," published in 1925, but is far more elaborate and in many respects more scientific, though it has the great defect, for English readers, at any rate, of being confined almost exclusively to the oilfields of the United States of America. Professor Lilley seems to have very little knowledge of the conditions in other oilfields; Egypt and Persia are indeed mentioned, though not much more than mentioned, whilst the information concerning Roumanian and Russian oilfields is extremely scanty. On the other hand, the oilfields of the United States are very fully dealt with.

The book opens with three introductory chapters on the nature and properties of petroleum and of various mineral bitumens related to petroleum, and discusses at some length the chemical properties of these substances. The author has an interesting chapter on the origin of petroleum, and apparently concludes that it has been produced from organic and not from inorganic sources, a view which to-day is tolerably widely accepted. He then discusses in the next thirteen chapters the geological conditions under which petroleum may occur, and describes in detail the various oilfield structures, laying naturally considerable stress upon folding and faulting; salt cores are also adequately considered. There is a final chapter on the exploration of new areas, which is distinctly disappointing. It might fairly be expected that in a book published to-day geophysical methods of investigation would have been dealt with in some detail, but the author compresses all he chooses to say upon that subject into four pages, and he appears not to realise the extent to which these methods have been used in oilfields other than those of the United States and of the important results obtained by them.

The work is no doubt one that no geologist interested in the occurrence and distribution of petroleum can afford to neglect, but it must be admitted that it will be of far greater value to those working in the oilfields of the United States than to those engaged in other countries.

BOOKS RECEIVED.

The Future of Tin. By H. Oakley and Evan Prichard. London: The Saint Catherine Press, Stamford-street, S.E. 1. Price 6d. net.

Definitions and Formulæ for Students: Electrical. By P. Kemp. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 6d. net.

Definitions and Formulæ for Students: Heat Engines. By A. Rimmer. London: Sir Isaac Pitman and Son, Ltd., Parker-street, Kingsway, W.C. 2. Price 6d. net.

A Handbook for Oxy-Acetylene Welders. Second edition. By L. M. Fox, M. Inst. M.E. London: Allen-Liversidge, Ltd., Victoria Station House, S.W. 1. Price 3s. 6d. net.

Report on the Economic Conditions in France in 1928. By J. R. Cahil, C.M.C. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 1. Price 5s. net.

The Ignition of Firedamp by the Heat Impact of Rocks. By M. J. Burgess and R. V. Wheeler. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 9d. net.

Notes on the Seasoning of Timber. By J. T. McCormick, M.Sc., and R. E. Summers, A.A.C.I. Victoria: Superintendent of Laboratories, Munitions Supply Board, Maribyrnong, Australia.

Life and Work of Sir Norman Lockyer. By T. Mary Lockyer and Winifred L. Lockyer, with the assistance of Professor H. Dingle. London: Macmillan and Co., Ltd., St. Martin's-street, Price 18s. net.

A Pulverised Fuel Ship.

SOME time ago the announcement was made that the Buell Combustion Company, Ltd., had entrusted its marine development work in Great Britain to R. and H. Green and Silley Weir, Ltd., and that a programme of research work on the firing of marine type boilers with powdered fuel was being carried out at the works of Cox and Co. (Engineers), Ltd., at Falmouth. The tests referred to having been satisfactory, it was recently decided to equip half the boilers of the New Zealand Shipping Company's steamer "Hororata" with the Howden-Buell system. This decision was arrived at largely as a result of the interest which is being taken by Lord Inchcape and the directors of his associated companies in the question of pulverised fuel burning and its importance for the British coal industry. On Friday last in a party which included representatives of both British and foreign shipping and shipbuilding interests, we were enabled to attend the preliminary trials of the "Hororata," which took place off Falmouth. On Saturday, December 8th, the ship left a little before noon for London, and she arrived at Tilbury early on Sunday afternoon and docked later. She is scheduled to sail for New Zealand on Thursday, December 20th.

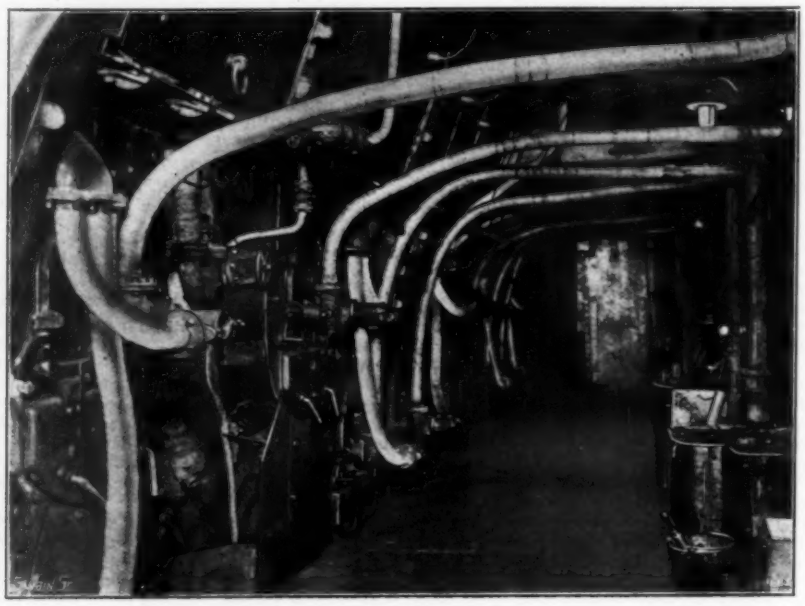


FIG 1—THE FORWARD STOKEHOLD IN THE S.S. HORORATA

The New Installation.—The "Hororata" is a twin-screw passenger and cargo steamer of about 11,243 gross tons, with a length of about 511ft. She was constructed in 1914 by Denny Brothers and Co., Ltd., at Dumbarton, and her propelling machinery comprises quadruple-expansion engines supplied with steam from six 200 lb. pressure single-ended coal-fired Scotch boilers, arranged back to back in two stokeholds. The boilers are of the four-furnace pattern, and Howden's standard forced draught arrangement is fitted. The three boilers in the forward stokehold of the ship have been converted for burning pulverised fuel, and for the first voyage, at any rate, the boilers in the after stokehold will continue to be hand fired with the same kind of coal. For the forthcoming voyage Townley run-o'-mine coal—a North Country fuel—will be used.

The Pulverising Plant.—A cross bunker in the forward stokehold has been removed to make room for the crushing, pulverising and distributing plant, which is self contained in the space immediately forward of the boiler-room. As there was a limited supply of electrical power available, only the crushers and elevators are motor driven, the remainder of the plant being operated by small steam turbines, which exhaust to the auxiliary condenser.

The coal is delivered from the port and starboard side bunkers on to a grate with bars spaced about 3in. apart, and falls directly into a short elevator which lifts it to the crusher. There are two identical crushing and elevating plants placed one in either corner of the machinery space. A further larger elevator raises the crushed coal to a large daily-use service bin, the lower part of which is provided with ducts leading to the three pulverisers. The upper part of the bin is tapered inwards, so that it coincides with the angle of repose of the coal, and renders trimming unnecessary. The elevators and crushers were supplied by Fraser and Chalmers Engine Works, Ltd. The crushers are driven by a 7½ B.H.P. motor and the large and small elevators have 7 B.H.P. and 3 B.H.P. motors respectively. We understand that, when working, much smaller powers are actually taken. The daily-service bin can be filled in about three hours. The three pulverisers are of the Fuller-Bonner ball mill type, and were supplied by Babcock and Wilcox, Ltd. They are each driven by a 20 B.H.P. Greenwood and Batley De Laval type steam turbine. From the pulverisers the powdered fuel passes to turbine-driven fan units which were constructed by the Sturtevant Engineering Company, Ltd. They are arranged on a raised platform above the pulverisers, and are driven by a 10 B.H.P. steam turbine. The powdered coal leaving the fan along with the primary or carrier air, passes through a shallow duct in which four guide vanes with adjustable deflectors are arranged. By moving the deflectors, more or less fuel and air is diverted to the flexible hose connections, leading to the burners, shown in Fig. 1 and 2. Close to the boiler-room a plug cock is arranged in the fuel supply piping which enables the fuel to be cut off from any pipe line.

The Howden-Buell Burner.—A view of the forward stokehold of the "Hororata" is reproduced in Fig. 1, while in Fig. 2 the burner arrangement on the Howden furnace front is more clearly shown. The patented Howden-Buell burner has been developed from the original Buell burner, and has been largely modified as a result of the experimental work carried out at Falmouth. As will be seen from Fig. 2, the fuel passes with its carrying air to a volute-shaped chamber connected with the circular burner casting. There is an interior tube terminating in an inner flange, which is extended outwards to take an inspection door. The burner is of the triple flow type, the fuel being projected into the furnace between two bodies of primary air, while the heated secondary air is supplied centrally from the ordinary Howden heater by the flexible hose connections indicated to the right of Fig. 2.

The whole arrangement is a very neat one, and the design is such that a boiler can be changed over from pulverised fuel to hand firing in a few hours. As the amount of refractory material used in this furnace front is very small, except in cases of semi-anthracites or low-volatile fuels, any ash falls on to the water-cooled bottom plate and can be taken out in the form of a fine powdery dust. As shown in Fig. 1, the boiler-room arrangement of burners and pipes is well laid out, and on trial the burners worked remarkably well, although their erection had only been completed the day before the demonstration trials, and there had been no time to make final adjustments.

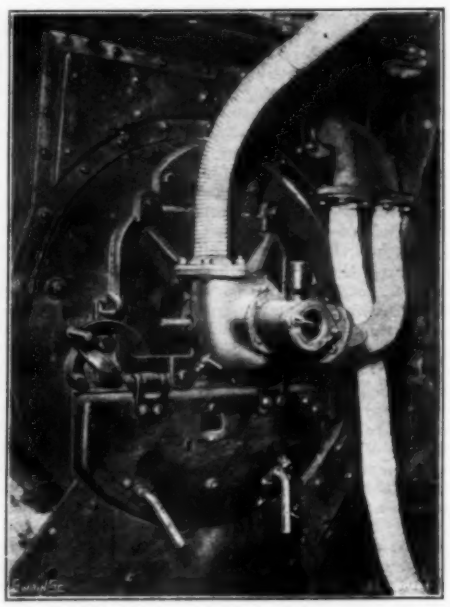


FIG. 2—THE HOWDEN-BUELL BURNER

After the trial we requested that one of the smoke-boxes, both on a pulverised fuel fired and a hand-fired boiler, should be opened up, and it was interesting to see that there was no deposit in the tubes and smoke-box ends, and that on the whole the pulverised fuel boiler ends were cleaner than those of the hand-fired boilers.

As regards ash, it was not necessary to draw the ashes from underneath the furnaces, even when the ship reached London. The ash was of a light powdery nature. There was no deposit of ash on the deck during the trip. The average combustion chamber temperature varied between 900 and 1100 deg. Cent., and the average CO_2 content of the flue gases was about 13½ per cent. The temperatures were comparable with those of an oil-burning installation operating under the same conditions.

Comparative Trials.—During the forthcoming voyage an opportunity to test the relative steam-raising capabilities of the two types of firing will be taken, and Mr. Bernard Silley is accompanying the ship for this purpose. It is probable that the three boilers in the after stokehold will be fitted with pulverised fuel firing at a later date. The present arrangement of elevating, crushing and pulverising plant may be considered, we were informed, to be tentative, and R. & H. Green and Silley Weir, Ltd., are now carrying out tests with new types of pulverisers, which, if successful, will enable ships with from 8000 I.H.P. to 10,000 I.H.P. machinery output to carry a twin pulveriser only. By this means the space taken up will be very small, and cost reduced. In the shore tests, an improvement of over 30 per cent. in evaporation was obtained by firing a marine boiler with pulverised fuel, and even better results were recorded in the overload trials. There is no doubt that, in this installation, a further forward step has been taken in the application of pulverised fuel firing for marine use.

The Corrosive Attack of Moorland Water on Concrete.*

THE action of water, either fresh or salt, on concrete surfaces has been made the subject of investigation and experiment by engineers for many years, and increasingly as cement concrete has become more generally used for constructional work.

It is not the object of this paper to deal with the subject generally, but to describe a particular instance of the deterioration of concrete surfaces due to contact with moorland waters, its effect on the design and construction of hydro-electric installations, and also to give some particulars of a series of tests carried out to ascertain the best materials for resisting such action.

The Kinlochleven works of the British Aluminium Company, Ltd., were constructed in 1905–9, the principal concrete structure being a dam 3112ft. long by 90ft. maximum height, situated 1000ft. above sea level in the Blackwater Valley on the western side of the moor of Rannoch. The catchment area is chiefly granite formation, covered by peat of varying depth. From the dam the water is carried in a reinforced concrete conduit, 8ft. wide and 8ft. deep in section, and 3½ miles long to the head of the steel pipe line, which leads to the power-house.

In course of time, all concrete surfaces exposed to water, whether still or running, have been affected, the smooth surfaces formed by working the concrete against planed and oiled timber shuttering becoming rough. The cement has disappeared from the faces, leaving the grains of sand and small aggregate exposed. The sand grains can be removed by rubbing with the hand. The depth to which the action has taken place is small, and probably does not exceed ¼in., therefore the stability of the structure is not affected. In the case of the conduits, however, the deterioration of the surface has increased the coefficient of friction, and thereby reduced the carrying capacities, with a consequent decrease in the maximum possible output from the power station.

Analyses of the water, and tests made in the laboratories, showed that the acids in the peaty moorland water dissolve the lime and calcium aluminate in the cement, and somewhat rapidly remove the face of the concrete, the action becoming much slower as the area of cement exposed is lessened by the presence of sand grains. In order to determine the best cement or other material to be used to resurface the conduit when the necessity arises, and also with a view to dealing with the new works at Lochaber, experiments were commenced in 1921 on the resistance of various cements and protective coatings to this corrosive action, and some 113 possible materials have been tested. They consist of varying mixtures of Portland, slag, and aluminous cement concretes, tars, bitumens, bricks, renderings, chemical surface treatment, proprietary and others.

A small conduit, 4ft. wide and 4ft. deep, constructed for carrying the water collected from a small watershed adjoining the main conduit to this conduit, was selected for the tests. The first tests consisted of exposing internal linings to the water, and, subsequently, as the number of materials to be tested increased, loose slabs of concrete were prepared and set in the conduit for contact with the water. These linings and slabs were formed of various concretes to be tested, or consisted of a standard mixture of 4 : 2 : 1 Portland cement concrete on which coatings were tested. The internal linings were 4½in. thick, divided into bays, 6ft. long, each side having a different material. The slabs were 2ft. by 2ft. by 4in. thick. The majority of the tests showed definite deterioration at the end of one year, and only a few were unaffected after a period of years; of these, aluminous cements were outstandingly good, and certain painted and chemically treated slabs were promising.

THE ACIDITY OF MOORLAND WATER.

A large number of tests have been carried out on the nature of the water which is responsible for the solution of the concrete referred to, and to this end practically the whole of the two watersheds of the Blackwater Reservoir, Argyllshire and Loch Treig, Inverness-shire, have been closely examined. The method adopted in the measurements was that known as the determination of the P_H value of the water. Briefly, P_H is a number used to express the active acidity or alkalinity of a liquid. The figures used range from P_H1, which is strongly acid, through P_H7, which is neutral, to P_H13, which is strongly alkaline. In this paper the range concerned lies between P_H4 and P_H8. The numbers, in effect, are logarithms, and each unit decrease in P_H represents a tenfold increase in acid value. That is, P_H5 represents ten times the acidity of

* Paper presented to the Institution of Water Engineers on December 7th, 1928, by W. T. Halcrow, M. Inst. C.E., G. B. Brook, F.I.C., M. Inst. M.M., and R. Preston, M.Sc. Abstract.

P_H6. The method of measuring P_H adopted in these tests was a colorimetric one. A portion of the water whose P_H is required is mixed in a small glass tube with a small quantity of indicator. The colour resulting is compared with a range of sealed glass tubes of different P_H values, each containing a little of the same indicator, and whose P_H values are known. This method is the only practical one for determining acids which are present in such minute quantities as are found in reservoirs, lakes, and streams.

For those not familiar with the terminology P_H, the acid values are given in the following table as arbitrary numbers, expressing comparative acid strengths :—

TABLE I.—*Acidity of the Water Supply.*

State.	P_H	Arbitrary number.	Example.
Alkaline	7·2	— 10	Small stream feeding Loch Treig
Neutral	7·0	± 0	Ditto
Acid	6·6	+ 16	Average acidity of Loch Treig
,,	6·4	+ 25	Average acidity of Blackwater Reservoir
,,	6·0	+ 63	Max. acidity found on Treig watershed
,,	5·4	+ 250	Max. acidity of streams on Blackwater watershed
,,	4·4	+ 2500	Max. acidity of any marsh on Blackwater
,,	4·0	+ 6300	Highest acidity found

An idea of the quantity of acid present in the water of these reservoirs is given by the fact that P_H 6·6 and 6·4 represent the equivalent of 0·015 and 0·024 part of acetic acid per million parts of water respectively. The acids resulting from the decomposition of peat have not been extensively investigated, and reference should be made to the literature on them for information. They are reported to be compounded of humic, acetic, formic, glycollic and oxalic acids, humic preponderating. In dry, frosty, or hot weather, acidity less, and with increasing wet weather, the acidity increases relatively, but not strictly so.

THE ACTION OF WATER OF VARIOUS ACIDITIES ON CEMENTS.

It is common knowledge that water has a solvent action on cement. How the rate of solution is increased in presence of acids is shown in this investigation carried out on the solution of Portland cement, and a new type of cement known as aluminous cement, in water and dilute acid. Portions of two test pieces of set finely ground Portland cement and aluminous cement were ground to pass 90-mesh seive, and the powders after shaking with 500 cc. of pure distilled water, allowed to stand for twenty-four hours. The supernatant liquid was decanted at intervals, and the quantity of solid matter in the liquid determined. The results of repeated lixiviation are given in Table II.:—

TABLE II.—*The Solution of Portland and Aluminous Cement in Water.*

	Portland cement. Percentage dissolved.	Aluminous cement. Percentage dissolved.
1st lixiviation	6·2	3·4
2nd ,,	4·0	2·8
3rd ,,	3·0	2·2
4th ,,	1·6	1·7
5th ,,	1·2	0·8
Total	16·0	10·9

With coarsely powdered cements, the quantity dissolved during two days' contact with water was only 1·7 per cent. of Portland and 1·0 per cent. of aluminous cement, When small pieces of Portland cement were immersed in dilute acetic acid for twenty-four hours, an increased solution was observed.

TABLE III.—*The Solution of Portland Cement in Dilute Acid.*

Strength of acid.	Percentage dissolved in 24 hrs. calculated as lime.
0·138 N	2·7
0·069 N	2·4
0·034 N	1·0
0·0069 N	0·25
Nil	0·02

To appreciate fully the significance of these figures it should be noted that lime is soluble to the extent of 1·3 gm. per litre in water, and it is calculated that the maximum solution possible if the cement were to remain in the water over a period long enough to ensure saturation with lime would represent 4 per cent., against the value of 0·02 per cent. for twenty-four hours. It is evident that, even though saturation has not occurred in any of the experiments, the presence of dilute acid has increased very markedly the rate of solution of cement. In order to treat this accelerative influence of acid in very dilute solutions, of the order found in practice, a different method has to be used from that outlined above Three buffer† solutions of P_H value 6·0, 6·6, and 7·0, were made up, and the change in P_H due to the solution of lime from cement placed therein was determined colorimetrically. The results are shown in Table IV.:—

TABLE IV.—*The Effect of Very Dilute Acids on Cement.*

P_H of original solution.	Relative acid strength.	P_H after 18 h. with cement.	Change of P_H calculated as lime dissolved.
6·0	100	6·5	0·02 gm.
6·6	25	6·7	0·005 gm.
7·0	10	7·0–7·1	0·0025 gm.

There is a distinct relation between the relative acid strengths of Col. 2, and the quantity of lime dissolved shown in Col 4. The rate of solution of concrete in dilute acid would appear to be directly proportional to the P_H of the acid for those ranges.

Analysis of the solution of acetic acid which had been in contact with Portland cement and also with aluminous cement for several days showed that the dissolved substances are mostly lime in the former and lime and alumina in the latter.

TABLE V.—*Matter Dissolved from Portland and Aluminous Cement by Dilute Acetic Acid.*

Portland cement.	Per cent.	Aluminous cement.	Per cent.
Silica	1	Silica	3
Alumina and iron oxide	2·5	Iron oxide	7
		Alumina	38
Lime	96·5	Lime	52

The comparative resistances of Portland and aluminous cements to acids is shown by the fact that while 3 per cent. of a test portion of Portland cement dissolved in an acid solution in twenty-four hours, only 1·5 per cent. of a similar test portion of aluminous cement dissolved under similar conditions.

It is of some interest, having in mind the facts elucidated by these experiments, to examine the actual concrete which has been exposed to water for many years. Samples of concrete chipped from the walls of a conduit were analysed, with the results shown in Table VI.:—

TABLE VI.—*Analyses of Concrete from a Conduit after Fifteen Years' Exposure to Water.*

	Sample. No. 1.	No. 2.	No. 3.	No. 4.
Silica	53·7	50·7	50·5	38·2
Alumina	8·4	9·1	10·7	16·1
Iron oxide	3·2	3·6	3·3	14·1
Titanium oxide	0·9	0·9	—	2·1
Lime	33·0	34·4	33·8	17·4
Manganese oxide	—	—	—	0·2

Samples Nos. 1 and 2 were obtained by breaking down the large pieces of concrete and retaining the fine material only for analysis. They represent, therefore, the average analysis of the conduit wall to a depth of 4in. to 5in. Samples Nos. 3 and 4 were scrapings from the surface, No. 3 above and No. 4 below the water line. The feature of the results is the great loss of lime which is evident, particularly in the concrete below the water line.

Another examination was made of some neat cement luting which had chipped off the edges of a portal of a conduit in service. Three distinct zones are evident—an outside, soft, brown-coloured layer of about 1 mm. thickness; a penultimate white layer of the same thickness; and internally the bulk of the cement of grey colour. The results of analyses of these layers or zones are given in Table VII below :—

TABLE VII.—*Lime and Silica Content of Cement Luting after Exposure to Water for Fifteen Years.*

	Outside. Per cent.	Middle. Per cent.	Inside. Per cent.
Lime	8·5	28·9	53·1
Silica	26	23	16

In combination, these would furnish 34·5 per cent., 52 per cent., and 69·1 per cent. of lime silicates in the three zones respectively, comparing with a value of 80–83 per cent. in normal Portland cement.

The water to which this cement had been exposed was of moorland, peaty origin, with a P_H of 6·6.

Many reports and patents have been published on methods of protecting concrete from water, and a brief summary of the conclusions reached is of interest. Additions to concrete in the mixing improve the resistance, but result in a decrease in strength. Finely powdered materials are an advantage, owing to their effect in reducing the permeability. Paints and varnishes are unsatisfactory, but oils of "drying" properties are of value for a considerable time. Sodium silicate is not reported to decrease the permeability to a marked extent, and is thought by some to cause scaling. Addition of slag is generally agreed to be without advantage, but paraffins, waxes and stearine are useful; so are fatty oils and soap. Resinous materials and aqueous solutions are not durable. Renderings of rich mortars and neat cement are widely used; in fact, the richer the mixture, the better the protection.

RESULTS OF FIELD TESTS.

Viewing the tests as a whole, it can be stated that, with few exceptions, all the materials tried were able to withstand the vigorous conditions better than standard Portland cement concrete. In the short period of 270 days, ordinary concrete appeared to have reached its worst possible state, and at 1800 days appears to be no worse than it was four years before. High-grade aluminous cement concrete shows no sign of deterioration, even after six and a half years' exposure to the acidic moorland water. It has every appearance of permanency. The original marks of the shuttering can be seen after about five years' exposure. This result is somewhat unexpected, in view of the laboratory tests which show that this cement dissolves in water at about half the rate of Portland cement. It can only be accounted for by the possibility that hydrolysis of lime aluminate has been retarded by the insoluble pore-abstracting nature of the alumina hydrate produced; or during the setting of the cement the free alumina produced—which is much less soluble than the free lime produced during the setting of Portland cement—acts in the same manner. A neat rendering of this type of cement is also very resistant, but is not to be recommended on account of the cracks which develop when used neat; they are conceivably due to insufficient curing. Mortars of sand and aluminous cement are similarly unaffected by water.

The only other material which shows no change after six years' exposure is Staffordshire blue bricks. Of the calcareous cements, only one kind merits favourable mention, namely, the finely ground or rapid-hardening type. The one tested is undoubtedly superior to common Portland cement. Used in the form of a mortar, a reasonably durable surface is obtained. It should be mentioned here that cements supplied neat are very durable, whether of a calcareous or aluminous nature, but they all suffered from a peculiar surface decay in the moorland water in which they were tested. This decay took the form of a softening of the surface to a depth of about ·02in., the top layer of dusty "dead" cement being removable in places by rubbing.

Mortars of the rich type—2 sand to 1 cement—are satisfactory for a considerable time, but eventually their surface roughens, though they have the advantage over concretes in that the surface at its maximum deterioration is not as rough, on account of the absence of coarse aggregate in their composition. Where the more stable cements, such as aluminous cement or other rapid-hardening cements are used in mortar facings, the results are, of course, better.

Before passing to the description of external treatment of material other than cements and mortars, mention should be made of a surface composed of equal parts of aluminous cement and Portland cement. The chemical reactions during the set of these two cements result in the production of free alumina and free lime. A mixture of the two would appear to be useful if the hypothesis can be entertained that combination between the free lime and alumina takes place. There is much prejudice against the use of these two different types of cement together, but an actual test shows some promise. Test R62 was of a surface of equal parts of neat aluminous cements and Portland cements, and, apart from a few surface cracks, it is still hard and sound after nearly three years. The cracks are local, above the water line, where occasional drying out occurs, and are most probably due to the aluminous cement, which experience shows is more likely to crack when used neat. A reduction in the proportion of aluminous cement and care in the curing would probably eliminate this defect.

Of the paint and oil surface treatments, there are several which appear able to stand up for a long period. Those of bitumen and tar basis appear the superior of the two classes. Bitumen is one of the most waterproof materials known, and has been used with success in pipes and tanks. A thick coating of a good quality bituminous enamel or paint endures well, and similarly a tar-lime mixture has a long life; it is, moreover, quite a cheap material. After five years' immersion a large amount of the bitumastic surface on one test piece has been dissolved, but the result is creditable. There are signs of oxidation evident on most of these bituminous substances, taking the form of a discoloration of the surface which changes from deep black to brown in course of time. Although the longest period of test of these materials is a little over four years, there appears every likelihood of their enduring for twice or three times that period; in fact, a similar substance has been successfully applied to a steel pipe in the Kinlocheven hydro-electric scheme, and has shown little, if any, deterioration after ten years.

Next to bituminous materials, the oil emulsion offers a material of fairly long life and one which is applicable to wet or dry concrete. The oil used most successfully in these emulsions was chinawood oil, which emulsifies easily, and dries to a waterproof tough film. The drying process can be accelerated by the use of a suitable drying agent. Another promising material of a similar nature is found in a mixture of this oil with Portland cement. The softening of the surface characteristic of neat cement facings is not evident with this treatment, and the result of two years' exposure is encouraging.

Of other surface treatments, soap solutions fixed with acid, and a mixture of soap, oil and wax may be cited as examples. Materials of these kinds would withstand very well under less rigorous conditions. They do not appreciably affect the colour of concrete and have possibilities in preserving buildings against weather, or when used in conjunction with other means of protection, such as final treatment for rich concretes and mortars. A further example of this type of treatment, in which rich concrete of a rapid-hardening type has been treated with an oil application, has its surface still intact after 400 days' immersion.

The water glass type of treatment registers a marked improvement over plain concrete, even after only 300 days' exposure. In this particular example, eight successive applications of soda silicate were made, and the result is typical of many of the water soluble treatments made.

There is only one of the incorporations in concrete worthy of mention, namely, that in which a quantity of fine material was used as a filler, as, for example, red oxide residue produced in the treatment of Bauxite for the extraction of alumina. The surface is certainly corroded, but not nearly as much as plain concrete. This material is mentioned because it achieves the double purpose of pigmenting the concrete without loss of water-resisting power.

CONCLUSION.

In hydro-electric installations, the loss of head in aqueducts is a matter of great importance, and particularly so when they are of considerable size, as, for example, the Lochaber tunnel, which is to be over 15 miles long and 15ft. in average diameter, and with which this paper is indirectly concerned. The experiments which have been described show that it is possible to restrict the deterioration of concrete surfaces, and therefore the increased friction losses, but at some cost, and the problem of deciding upon the coating to be used in a concrete conduit thus becomes an economic one.

If the surface of the lining of an aqueduct deteriorates, the coefficient of friction increases, and consequently there is greater loss of head for an equal quantity of water, and therefore loss of power. If materials are used which resist corrosive action, the surfaces will remain smooth and give the equivalent of a gain in horse-power over ordinary material in the course of years. The problem thus generally stated is complicated by several other factors, including the load factor of the power station. It has been shown that the use of concrete made with aluminous cement of good quality will keep deterioration at a minimum, but as at present it costs about twice as much as Portland cement, a decision as to the advisability of its adoption can only be arrived at economically.

No other materials, with the exception of Staffordshire blue bricks, appear to give promise of permanent resistance to corrosive attack by moorland waters.

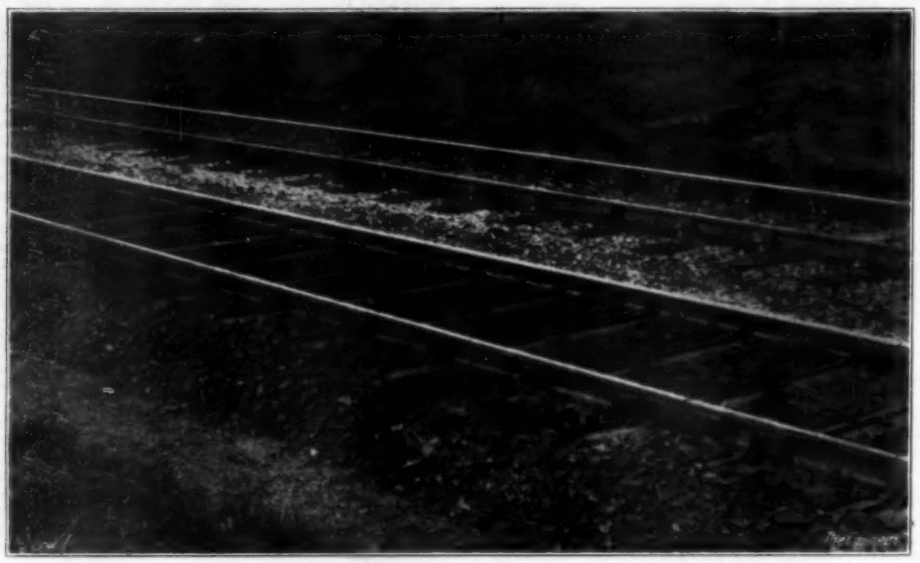
The authors are indebted to the British Aluminium Company, Ltd., for permission to publish the results of their investigation; to Mr. Francis Wilson and Mr. H. J. Simcox, for their assistance in the production of the difficult photographic records of the test slabs and panels *in situ*; and to Mr. G. H. Stott for many of the analyses and the field activity tests.

† A "buffer" solution is one which tends to maintain its acidity or P_H. It possesses "reserve" acidity against change. A definite quantity of alikali is required to alter the acidity.

Steel Sleepers.

THE SANDBERG TYPE.

IT is now nearly fifty years since steel sleepers were first tried on an extensive scale in this country. Some 100,000 of them designed by Mr. F. W. Webb, were rolled at Crewe Works and put into service on the London and North-Western Railway between 1880 and 1890. No more were laid after the latter year, and by 1900 there were only 46,000 in use on the main line. It is, however, due to Webb's memory that it should be recorded that after a lapse of at least forty years some are still in the road. They failed because the ends were left open so as to meet the difficulties of packing; and in consequence they lost their alignment. They were also noisy. Corrosion was no more than a minor cause of failure and was experienced only where the ballast was unsuitable.



SANDBERG STEEL SLEEPERS ON THE SOUTHERN RAILWAY

A steel sleeper—for a flat-bottom rail—was invented in 1887 by Mr. J. Cabry, the chief engineer of the Southern Division of the North-Eastern Railway. Many of the type were laid on that line, but Mr. H. Copperthwaite, who succeeded Mr. Cabry, said at the Engineering Conference held at the Institution of Civil Engineers in 1897, that the results had been disappointing. The first cost had produced no proportionately longer life, and he did not know of any metal sleeper in Great Britain which was giving good results under heavy and fast traffic. Mr. Copperthwaite added that it was only right that he should say that the failures had been specially marked on lines where ashes had been used for ballast.

The lack of success that attended the use of steel sleepers on the London and North-Western and the North-Eastern Railways, particularly the former, had an unfortunate result. Had the situation then been as vital as it is to-day, there is no doubt that a satisfactory sleeper for use in this country would have been evolved. There were, it is true, difficulties to be overcome. One outstanding feature which prevented British railways from adopting steel sleepers, such as those used in India, South Africa, Germany, Mexico, &c., was that they were for a flat-bottom rail. That type of rail is secured at the base, and the sleeper needs only two clips or lugs on the top, between which the base of the rail is laid and is held there by either a nut and bolt or by a tapered metal key. On British railways a chaired sleeper was a *sine quâ non*.

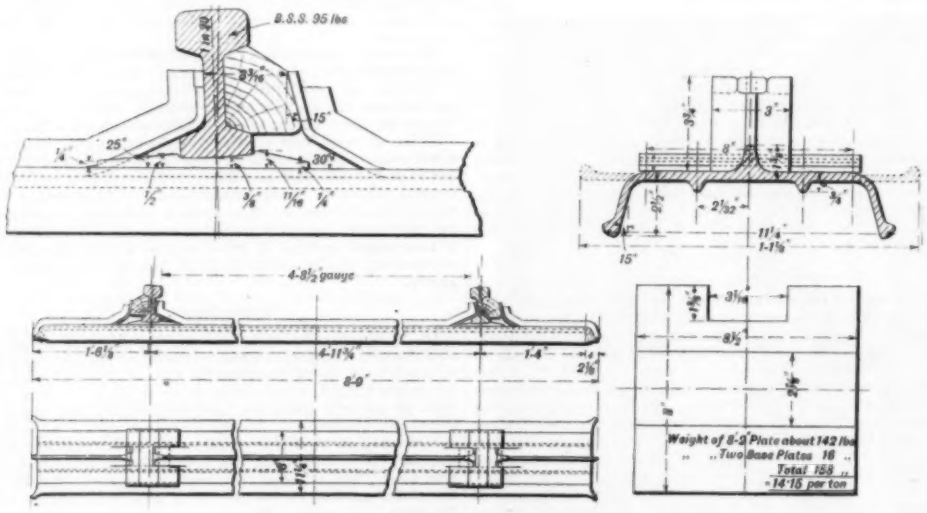
But whilst the form of rail was a main factor to be contended with, there were other factors that encouraged the retention of the wooden sleeper. A good supply of suitable timber was obtainable from the Baltic and North America. It was, at that time, comparatively cheap and the freight charges were low. Many of the companies had their own creosoting works whither the timber, already cut to size, could be delivered by water. They had also their own chairing plant and the sleepers could be sent out, with the chairs fastened to them to gauge ready for the rails.

Meanwhile, the timber supply was getting reduced in quantity, and in quality also, and, with the war, came a big increase in freight charges and, what is more, the recognition of the fact that we were dependent upon overseas for our supplies. In view of these circumstances, Mr. C. Peter Sandberg attempted to solve the difficulties of designing and introducing a steel sleeper for the British bull-head rail. In his work he was supported, first by Mr. A. W. Szlumper, the chief engineer of the then London and South-Western Railway, who ordered several thousand for trial, and by Mr. E. C. Trench, the chief engineer of the former London and North-Western.

The matter is again being considered by the railway companies generally and with becoming importance. The engineers of the companies, through their Railway Engineers' Association, are also alive to the situation. A Committee—which is still active—was formed to consider the question and it secured the co-operation of the steelmakers in the discussions on the subject.

The present order for 70,000 sleepers, placed by the Southern Railway with the United Steel Companies, is the result of the experience gained by Mr. Szlumper. Speaking at the Engineering Conference on June 5th, held in connection with the Centenary of the Institution of Civil Engineers, Mr. G. Ellson, who succeeded Mr. Szlumper as engineer-in-chief to the Southern Railway, said—see page 625 of THE ENGINEER of June 8th, 1928—that these steel sleepers had been in use on the London–Portsmouth main line for 7½ years and were in perfect condition still, whilst the ganger said they gave less trouble in maintenance than timber. The eight years' test shows that the sleepers meet all the conditions that have to be complied with in so far as maintenance is concerned.

The track circuit difficulty remains to be dealt with; meanwhile wooden sleepers can continue to be used in those lengths—about 10 per cent. of the whole to-day—that are track-circuited, and where track circuit in the near future seems possible. Then, later, a sleeper which will carry a check rail must be produced. The problem has been dealt with in certain forms of steel sleepers used for flat-bottom rails, and we have no doubt that a similar arrangement is possible for the bull-head rail.



THE SANDBERG STEEL SLEEPER

The accompanying drawing shows the Sandberg steel sleeper now to be used by the Southern Railway, whilst the photographic reproduction illustrates a length of the trial sleepers on that railway.

The sleeper is in one piece of pressed steel, $^{5}/_{16}$in. thick, strengthened by a rib in the centre along the whole length. On the underside, at $2^{1}/_{32}$in. on each side of the centre line, it is further strengthened by two ribs $^{3}/_{16}$in. to $^{7}/_{16}$in. thick. To obtain the necessary length for the inner and outer jaws, which are pressed upwards, the metal forming them is "joggle" cut. The inner jaw embodies the upper strengthening rib up to its top; the outer jaw consists only, at the top, of the main portion of the thickness of the main plate. The outer jaw is shaped at such an angle that when the wooden key—which differs in form from the ordinary key—is driven in, the rail and base plate are tightened on to the sleeper. Thus the inner, or gauge, jaw is the stronger, and even if the keys are driven excessively it is the outer jaw that springs whilst the inner maintains the correct gauge.

The base-plate is also of pressed steel, of the dimensions shown, and so shaped on the upper side as to give the inclination of 1 in 20 to the rail. The recess of $3^{1}/_{16}$in. by 1¼in. fits under the inner jaw.

Grid Coupling Switches.

THE interconnection of large direct-current distribution systems involves the provision of suitable sectionalising arrangements, for otherwise in the event of a breakdown, difficulties may be experienced in restoring the supply. The heavy initial load is unavoidable, because, when the supply fails, consumers do not switch off their apparatus; in fact, in the case of lamps, the tendency is for consumers to increase the load by switching on more lamps in order to ascertain whether it is their own wiring installation that is at fault. The difficulties of renewing the supply are also increased by the fact that the resistance of cold lamp filaments is considerably lower than that of heated filaments, with the result that the initial lighting current is increased by from 10 to 15 per cent. Thus it becomes essential to limit the initial load to a permissible amount, so that the first converter or rectifier can be put into service without difficulty. The best method of grappling with the problem is to subdivide the distribution system, so that the initial load of any given section does not exceed the limits of the sub-station to which it is connected. This practice has the additional advantage of ensuring greater protection against the effects of disturbances in neighbouring sections, for in the event of a short circuit only a limited portion of the section can be effected.

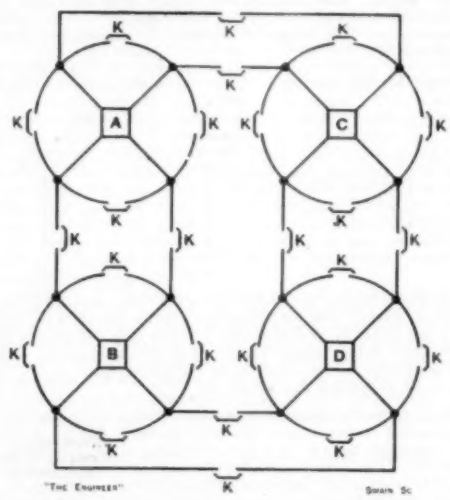


FIG. 1 GRID SWITCHES FOR FOUR SUB-STATIONS

Grid coupling switches for this purpose have been devised by Siemens-Schuckert, and are connected in the circuit in such a manner that on opening they disconnect a faulty section of the system from the adjacent sections, or in an extreme case resolve the whole system into its component parts, whilst, when the normal conditions are resumed, they automatically join up the sections of the system again.

The method of connecting the switches is shown in the diagram, Fig. 1, where four sub-stations containing rotary converters or rectifiers are indicated at A, B, C and D. These sub-stations supply current to their respective ring mains, into which the coupling switches are inserted, as shown at K, and also in the interconnecting mains. In the case of excess current or failure of the voltage, the switches disconnect and sectionalise the distribution system. As soon as the pressure on the sections is restored the switches automatically couple them together again. In the case of heavy short circuits, however, which generally necessitate investigation and removal of the fault, the coupling switches can only be closed after tripping an interlock by hand. If one of the sub-stations drops out by reason of a failure of the main supply, thus making a part or the whole of the network dead, one or all of the coupling switches will be opened by the no-volt releases.

When the supply is renewed, the converters in the sub-stations are again started up, and the feeders are switched in successively. In this way the load is applied to the converters gradually, and as the pressure is restored in the various sections of the mains, the coupling switches come into action until the whole system is again complete.

The diagram—Fig. 2—shows the connections for a two-wire system, but the same diagram applies to a three-wire system, for the neutral is not connected up to the switches, and does not play any part in their operation.

Disturbances caused by overloads are often of a transitory nature which do not justify disconnection, and adjustable time lags are therefore provided, for avoiding disconnection in these cases. If, however, the overload persists for a predetermined period, the switches open and close again on the restoration of normal conditions. In this case a time lag can also be brought into operation. On short circuits, however, the switches drop out without any time lag, and are held in the "off" position by an interlock, which, as we have said, must be released by hand. Switching-out is always effected by the operation of the no-volt release indicated in the diagram—Fig. 2—by R V, the core of which drops in the event of the current failing, thus initiating the movement of the main switch. This release also operates in the event of overloads and short circuits for the solenoid, and its series resistance A is in series with the auxiliary contacts C and B of the time lag controls E and F as well as with the contacts of the press-button switch G. If the excess current is greater than five or six times the normal value, the switch interrupts the circuit without any lag at all, because the cores of the control devices E and F are drawn up with such force that

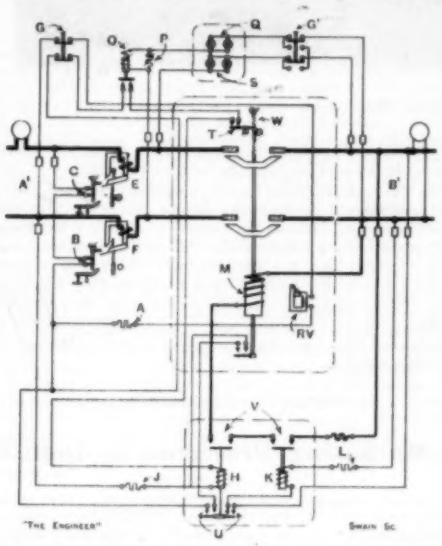


FIG. 2—CONNECTION FOR A TWO-WIRE SYSTEM

the springs attached to the coils are at once compressed, and the cores are held in position by latches. Before the main switch can be closed again the interlock must be released by hand.

On the restoration of the supply pressure, the auxiliary contactor H, which is connected to sub-station A^1, first of all closes through the series resistance J and several auxiliary contacts. As a result of this, the circuit of the auxiliary contactor K, which is connected through the resistance L to the sub-station B^1, is also closed. The operating magnet M then comes into action. The two contactors H and K can be regarded as the coarse part of the system, because they operate when either of the two pressures is considerably greater than it should be. To prevent the operation of the main switch under these conditions, however, the pressure difference contactor O is provided. This contactor can be adjusted by means of the resistance P, and it is connected in series with the lamp resistance Q to one pole of the main switch. When the switch is open, the circuit is completed through the lamp resistance S to the other pole. The contactor O operates as soon as the pressure on either side of the main switch varies by more than $\pm$ 5 per cent.

The object of the lamp resistances S and Q, which are low at low pressures and high at high pressures, is to protect the windings of the contactor O, which is required to maintain the circuit closed at a very low voltage, but which must not be damaged if subjected to the full line pressure, as, for example, when the sub-station A^1 is dead, whilst the sub-station B^1 is working at full voltage. On the other hand, the action of this differential contactor is dependent on pressure variations. By closing the main switch, the contacts T, which are connected together when the switch is open, are separated, resulting in the interruption of the circuit of the contactor O, and the breaking of the circuit at the contacts U and V. With the exception of the no-volt release coil and the current controls, the whole of the coils and resistances are cut out under normal conditions.

The duration of the time lag between the time of switching out and switching in again is regulated by the retarder W, which is constructed on the same lines as those for the current controls E and F. By means of press buttons G and G^1, it is possible to test the operation of the grid switches whilst in service. The button G can only be operated by a special key, and by means of this device the circuits which control the switch can be put out of action. By pressing the button G^1 the lamp resistances Q and S are connected in series across the full voltage, and as long as they remain intact the lamps light up and their current closes the circuit of the auxilary contactor O.

THE INSTITUTE OF METALS.—The Council of the Institute of Metals announces that it has found it necessary to alter the date of the twenty-first annual general meeting and "Coming-of-Age" Celebrations of the Institute from that originally announced—March 6th and 7th—to March 13th and 14th, 1929. In addition to a dinner and dance at the Trocadero on March 13th, a conversazione and exhibition are to be held in the Science Museum, South Kensington, on March 14th, at which objects of special interest in relation to the work of the Institute will be displayed. Offers of such objects are invited and should be made to the Secretary, Mr. G. Shaw Scott, 36–38, Victoria-street, Westminster, London, S.W. 1. The annual May lecture of the Institute is to be given on May 7th by Sir Oliver Lodge, F.R.S. The annual autumn meeting will be held in Düsseldorf next September.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

AIRSHIP R 101.—ZINC-CADMIUM SOLDERS.

SIR,—Early in 1924 the British Motor Cycle Research Association, of which I am Director, called for a brazing alloy with a melting point high enough to withstand enamel stoving furnaces and low enough to flow without causing serious changes in steel, the application in view being the brazing of motor cycle and cycle frames. In September, 1925, Mr. R. B. Deeley, then a research assistant in the Association, read a paper before the Institute of Metals, entitled "Zinc-Cadmium Alloys—A Note on their Shear Strength as Solders." In that paper almost the complete range of zinc-cadmium alloys was dealt with, more especially in the neighbourhood of the eutectic. Shear strengths as high as 8½ or 9 tons per square inch were then given.

In view of this, the statement on page 599 in your issue of November 30th, that Messrs. Boulton and Paul's laboratory staff have discovered a new alloy "Cazin," with a shear strength of 7 tons per square inch, is particularly interesting.

It is not the purpose of this letter to raise any questions of priority, for in the present state of widespread research, combined with multitudinous publications, it is often difficult even for the most scrupulous to avoid occasional apparent plagiarism.

But since 1925 we have done a good deal of further work on these alloys, sometimes obtaining shear strengths as high as 11 tons per square inch, and it should be emphasised that these alloys have curious and obscure defects. They cannot be recommended with certainty where human life depends upon their use, unless very prolonged tests are made on the specific application in which they are embodied.

H. S. ROWELL,
Director of Research,
Research Association of British Motor and Allied Manufacturers.

London, W. 4, December 6th.

[The statement made in our issue of November 30th that Messrs. Boulton and Paul's laboratory staff had "discovered" the "new" alloy referred to as "Cazin" was based on a misunderstanding on our part. It is perfectly clear to us now that no claim to the discovery of this alloy has been or is made by the firm. The only innovations which it claims in connection with the zinc-cadmium eutectic consisting of 82·6 per cent. cadmium and 17·4 per cent. zinc are the application of the name "Cazin" to it and its use for the particular purpose for which the firm employs it. That purpose, as we explained in last week's issue, is the making of the capel ends of the longitudinal bracing cables. The cable end is splayed out and over it an internally coned fitting or capel is passed. The splayed end is then filled with "Cazin," the coned fitting serving as a mould. Subsequently forked ends are applied to the coned fittings. Before use each cable is stretched to 50 per cent. of its breaking load to take up initial permanent set.

We have passed Mr. Rowell's letter on to Messrs. Boulton and Paul for their comments, and below we give their reply.—ED. THE E.]

SIR,—With reference to Mr. Rowell's letter, we should like to say immediately that we make no claim for having discovered the zinc-cadmium eutectic, particularly as the metallurgy of the zinc-cadmium alloys was investigated and the results published by C. Hindrichs in "Zeitschrift für Anorganische Chemie" in 1907; moreover, after deciding to try zinc-cadmium we made ourselves familiar with the work of Mr. R. B. Deeley from his paper before the Institute of Metals in 1925, and, in fact, the figures in THE ENGINEER for the eutectic composition and the shear strength are the figures which Mr. Deeley gives in his paper.

The word "Cazin" has been adopted because it is obviously inconvenient to have to refer continually to material in an engineering works as zinc-cadmium eutectic solder.

Strictly speaking, in the form in which it is used in the joints for R 101 the alloy is not used as a solder. For example, white metal has been employed for a similar purpose. It was desired, however, to take advantage of the superior corrosion-resisting powers of zinc-coated cable instead of tin-coated, and the zinc-cadmium eutectic alloy was chosen as having many advantages.

It is hardly necessary to say that the use of "Cazin" for these cables is so different from the use to which it was put in Mr. Deeley's work that the specific application had to be very fully and thoroughly investigated.

Nevertheless, we feel that Mr. Rowell, in his emphatic statement that some of these alloys have curious and obscure defects, must necessarily throw suspicion on the reliability of this type of joint. Having said so much he will hardly refuse to say more, and we would ask him to be kind enough, either through your columns or to us direct as he prefers, to make clear what are the curious obscure defects which the investigations of his Association since 1925 suggest might be found in this application of the eutectic alloy.

FOR BOULTON AND PAUL, LTD.,
J. D. NORTH,
Chief Engineer.

Norwich, December 8th.

BELT DRIVES.

SIR,—Referring to Mr. Geo. F. Pardoe's letters in your issue of the 30th ultimo, it was never claimed that there is any basic difference between the old jockey pulley and the "Lenix" device, in that they are similar in their purpose to take up permanent stretch in a belt. The real point at issue lies in the method of application.

While in the design and manufacture of the "Lenix" device neatness and easy running are aimed at, the success or otherwise of this class of drive is almost entirely determined by proper selection of the belt. Little reliable information is published regarding the loading of belting for short centre drives, and experience, therefore, plays an important part. Not only power and revolutions, but also size of pulleys, nature of drive, atmospheric conditions and other factors affect the efficiency and durability of the drive.

As is well known, the power any belt will transmit varies with the arc of contact with the pulley and the object of a belt tightening device is to make this as large as possible without increasing thereby the stress in the fibre of the belt. The proper functioning of any such device can only be secured if the tension in the slack side of the belt is just, and only just, sufficient to prevent slip between the belt and the pulley. Consequently the supplementary weights must be chosen to give only enough pressure between the tightening pulley and the belt to secure the required minimum tension. Any excess of pressure applied by the tightening pulley increases the tension in both the slack and driving sides of the belt and correspondingly also the pull or load on bearings and shafts of the whole gear, thus nullifying one of the main advantages of a correctly designed short centre drive.

The jockey pulley was applied more or less by rule of thumb, in practical ignorance of the stresses resulting in the belt and its suitability for the work. The application of a "Lenix" device, on the other hand, comprises the examination of all the conditions governing the drive and the selection of a belt, the dimensions of which are known from experience to be adequate. The question does not, therefore, resolve itself simply into one of the sale of an article, but of the application of experience to secure the best results in its use.

P.p. SULZER BROS.,
F. SCHUBELER.

London, W.C. 1, December 11th.

STANDARDISED ENGINE TESTING APPARATUS.

SIR,—Sir Ernest Petter, in his letter in your issue of November 30th, draws attention to the important matter of testing of internal combustion engines.

There is no doubt that the extraordinary variability of results presented by different makers with no statement as to particular methods adopted in the test itself lead inevitably to all figures being, more or less, doubted, if presented in a general way. This, no doubt, has led many makers to go to the extent of having special tests made by expert consulting engineers before making public the results they have obtained.

I thoroughly agree that if makers could be got together in order to agree finally to some common method for engine testing it would be to the good.

There is, however, another side to this question that we cannot lose sight of, and that is with reference to continental work. On what basis are continental tests made, and what allowances, often so many, are made with the effect of improving the returns?

A. E. L. C.

December 6th.

SIR,—In my opinion the point raised by Sir Ernest W. Petter, in his letter published in your issue of November 30th, is one of great importance. I have for many years past had opportunities of realising the variety of methods of testing employed by many of the manufacturers of internal-combustion engines, and am therefore able to appreciate that Sir Ernest's comments are well founded.

The greatly varying types of apparatus, the acceptance of instruments which have been uncalibrated for considerable periods, dynamometers which appear never to have had any attempt made to keep them in a proper state of maintenance, deficient water supplies, these and other extraneous matters all too frequently impose conditions which must make test figures suspect.

Probably no real accord could be reached without a preliminary conference, but I think this would be well worth while.

W. A. TOOKEY.

Westminster, S.W. 1, December 12th.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY.—The annual dinner of the Imperial College of Science and Technology was held on Monday, December 10th, at the Hotel Victoria. Lord Buckmaster, the Chairman of the Governing Body of the College, presided. This event celebrated the twenty-first anniversary of the granting of the charter, whereby the Royal College of Science, the Royal School of Mines, and the City and Guilds Engineering College were federated under the title of the Imperial College of Science and Technology. Sir John Gilbert, Chairman of the Education Committee of the London County Council, in proposing the toast of "The Imperial College," said that the future was most promising. The University of London, with its new statutes and its site in Bloomsbury, had at the moment an opportunity that it had never had before. He was confident that, if all branches of the University of London worked together with the fullest co-operation, that co-operation could be made to be of the greatest advantage to the whole of the University education, not only in this country, but throughout the Empire. Lord Buckmaster, responding to the toast, mentioned that Professor W. C. Unwin, one of the original professors of the City and Guilds College when it was opened in 1884, would celebrate his ninetieth birthday on December 12th. He stated that there were 250 persons in the College engaged in the work of research. The toast of "The Guests" was proposed by Lord Morris, President of the Imperial College Association, and Sir Frank Heath and Sir William Pope, the Prime Warden of the Goldsmiths' Company—himself an old student of the City and Guilds College—responded on behalf of the guests. The toast of "The Chairman" was proposed by Mr. J. Combes, President of the Imperial College Union.

Preston-Blackpool Transmission Line.

FOR the purposes of supplying current from the Ribble power station of the Preston Corporation to Blackpool, an overhead transmission line has been erected. It has been designed for a working pressure of 49,500 volts, although at the present time the line is being worked at a pressure of only 33,000 volts. There are to be four three-wire circuits carried on Kay poles, but at present only two circuits have been provided. The 0·1 square inch copper conductors forming these circuits are carried on two parallel lines of poles for a distance of about 13 miles. The span is approximately 450ft., and the height of the poles is 40ft. The illustrations —Figs. 1 and 4—show the lattice steel structures that have been erected for the purpose of carrying the four three-phase 49,500-volt circuits, and two auxiliary lines insulated for the same pressure, across the river Ribble. The span between the two structures is about 500ft., and the towers are over 100ft. high. On the left of Fig. 4 is to be seen the structure on which the conductors are terminated, and eventually led into the brick sub-station in which the switchgear is housed.

The Preston sub-station, shown in Figs. 2 and 3, controls the 6600-volt, three-phase, 50 cycle supply provided by two parallel feeders from the Ribble power station to two 8000 kVA transformer banks connected star fashion on both sides, whilst 33,000-volt switchgear controls the high-tension side of the transformers, which feed the two parallel lines running to Blackpool. At Blackpool the step-down sub-station contains two 5000-kVA, three-phase transformer banks connected star fashion on both sides, and designed to reduce the pressure from 33,000 to 6600 volts. In each case, indoor cubicle type switchgear is provided on the first floor of the sub-station building, whilst underneath the switchgear in the lower part of the building—which has no outer walls—are placed the outdoor transformers. The oil circuit breakers and isolators are enclosed in cells with brick walls and horizontal barriers composed of moulded stone, all the phases being well separated. The cubicles thus formed are fitted with hinged sheet steel doors, with Castell figure locks and keys.

In the Preston sub-station the switchgear is divided into two compartments, one containing 33,000-volt gear and the other 6600-volt gear, whilst in the Blackpool sub-station only 33,000-volt gear is provided. In each case a hatchway in the floor of the switch-room enables the switchgear to be raised or lowered. The oil circuit breakers are of the English Electric Company's standard "O B B O" type, with a rupturing capacity of 250,000 kVA, and they are operated in accordance with the company's standard method, the control switches for the Preston sub-station being mounted in the power station. All insulators exposed to the outside atmosphere are of the standard 66-kV type, whilst the clearances are designed for 45,000 volts. The 6600-volt outside insulators and connections have 12,000-volt clearances. Each bank of transformers is built up of three single-phase, 1666-kVA outdoor steel type units, and one spare unit is provided for each sub-station. In each sub-station there is an indoor-type induction regulator, rated at 500 kVA at 6600 volts, with remote electric control for regulation within the limits of ± 10 per cent. As shown in Fig. 3, the two transformer banks are separated by a brick wall. All the sub-station work was carried out by the English Electric Company, whilst Callender's Cable and Construction Company was responsible for the overhead line, the complete scheme being carried out in accordance with the designs of the consulting engineer, Mr. J. A. Robertson, of Manchester.

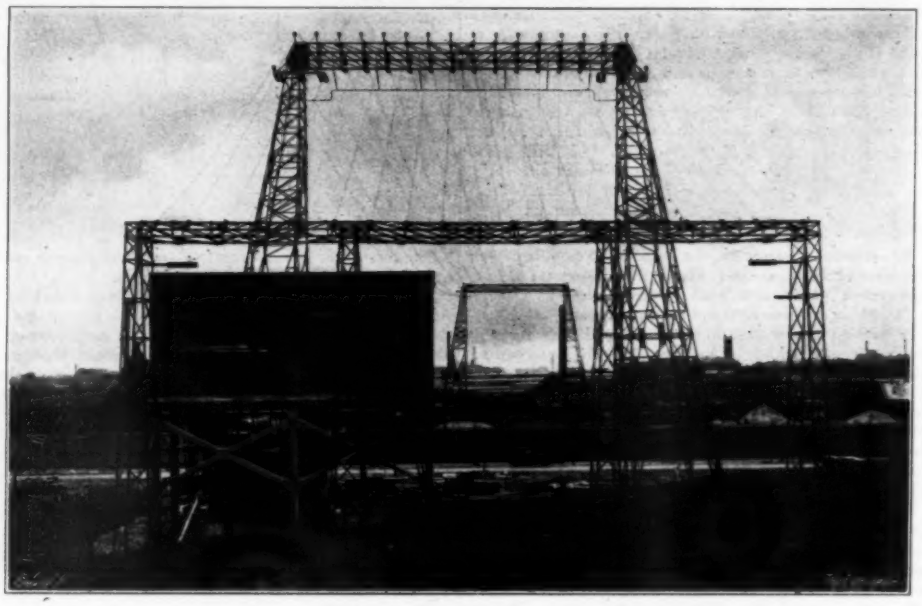


FIG. 1—OVERHEAD LINE AND SUB-STATION

FIG. 4—OVERHEAD LINE CROSSING RIVER AT PRESTON

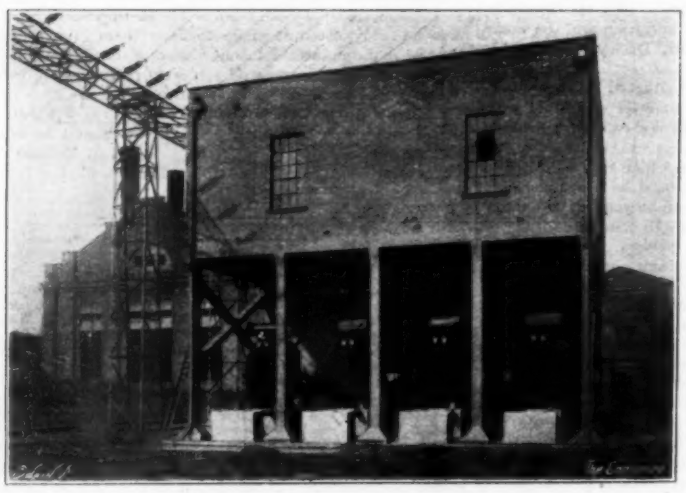


FIG. 2—SUB-STATION AT PRESTON

FIG. 3—END VIEW OF PRESTON SUB-STATION

Marketing Problems in India.*

IN his message to the Advertising Convention at Birmingham, H.R.H. the Prince of Wales recently stressed the importance of new and scientific methods of marketing which are demanded by modern conditions. This need for improved marketing systems lies at the heart of the British trade position in India to-day, and the crux of the matter is adequate representation. For the last ten years in these reports, I have consistently emphasised the fact that the British manufacturer can no longer afford to leave the marketing of his products entirely in the hands of others, but must himself take an interest in, and generally supervise the processes of, selling, propaganda, and advertising until the goods actually reach the ultimate consumer. After twenty-one years' business and official experience in two of our greatest markets—India and China—I state with firm conviction that the marvellous industrial strength of the United Kingdom is to a large extent dissipated, and British manufacturers fail to obtain their due share of the trade of the East owing to the fact that our marketing methods are not so scientific or carefully planned having regard to the needs of each country as our methods of production. An authority recently stated with great truth that "this great nation of manufacturers must become a nation of salesmen before it can hope to compete successfully in the world's markets." There is evidence of increased attention being paid to the specific needs of India, the greatest of all our markets, by a number of the more powerful British concerns during the past few years, but correspondence with hundreds of British manufacturing firms each year shows that the great majority have not yet appreciated the changed conditions in India which tend to weaken our position and which call for revised methods and organisation in order to meet them. I make no apology, therefore, for reiterating many of the comments which have been made before, but which apply with even greater force to-day.

* From Report on the Conditions and Prospects of British Trade in India, 1927–28, by Thomas M. Ainscough, his Majesty's Senior Trade Commissioner in India and Ceylon. Price 3s.

The number of efficient, modern selling organisations aedquately covering the Indian market and making full use of present-day methods of propaganda and advertising is extraordinarily few. The distribution of cigarettes, kerosene, certain chemical products, soap and sewing machines are outstanding examples of efficient marketing. In the case of heavy machinery and plant of all kinds, the manufacturers have in most cases established their own branches staffed with both commercial men and engineers. In the great majority of cases, however, British manufacturers have been content to leave the whole question of selling and distributing methods entirely in the hands of their mercantile agents in India. They have been prone to consider that once they received payment for the goods in London their interest in them ceased. They have not realised that mercantile agents in India have, as a rule, far too many irons in the fire to give close personal attention to any one agency unless they are assisted and prompted to do so by the manufacturer.

The only solution is for the producer to take a personal interest in the market and to realise that, without the expenditure of capital and trouble, he cannot hope to have his goods adequately distributed. In a certain number of instances, where business is conducted on a large scale, a branch in India is indicated. In other cases, and particularly where a machine, appliance, or article requiring special knowledge is being sold, the maker should attach his own expert to the staff of the agent, so that technical advice and service may be available on the spot. Where the manufacturer employs agents for the sale of a non-technical commodity, he should realise that it is too much to expect any local firm to undertake heavy expenditure on travelling, demonstration and propaganda work for a mere 5 per cent. commission on sales. In the case where a traveller is employed who is either resident in India, which is the more satisfactory procedure, or merely visits the country each cold weather, it should be borne in mind that a subsidy is required to cover advertising and other propaganda expenditure, including extensive travelling, and the manufacturer should make it his business to make sure that the territory is not too large to be adequately worked and that this subsidy is spent in the right way.

In conclusion, the manufacturer should realise that he has an interest in his goods until they reach the consumer. Unless he is prepared to put in a sales organisation himself or to insist that his agents should maintain an efficient organisation, he will run the risk of losing the trade. The pace, in any market, is that set by the most efficient competitor.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Inanimate Market.

THE Midland iron and steel market has settled down to a period of dispassionate and indifferent trading. Consumers have sufficient material either in stock or on order to carry them on until the Christmas holidays, and beyond that they are not prepared to go. Producers, apparently realising the faint chances of stimulating demand at this time of the year, especially under existing circumstances, make little effort to induce business. Makers of billets, however, have displayed more activity and have reduced prices in an endeavour to keep business on the move. There is, however, considerable activity on the part of foreign suppliers to be counteracted. Demand for iron, alike raw and finished, is of little worth, and output is in excess of consumptive requirements. Little bulk buying is to be expected until the resumption of work at the factories after the Christmas vacation.

Steel.

The steel trade is hardly so bright as it was, some falling off in demand having been experienced in practically every department of late. Constructional engineers are only moderately employed, but some useful orders are in the market. Competition is very keen, and prices are cut finely to secure the work. Rolling lists from the mills making sections indicate a wide variety of work, but no outstanding tonnages. Plate mills are in want of orders. The shipyards are rather busier, and plate makers are hoping that that activity will be shortly reflected in larger inquiries for plates. Prices of heavy steel remain unchanged, and the recently ruling rates of £7 17s. 6d. for joists and angles and £8 12s. 6d. for plates still hold good. In the half-products branch, however, prices have fallen slightly. Local billet makers have this week accepted business at £6 5s. Sheet bars are named £6 2s. 6d. In how great a measure the fall in values is due to the resumption of work in the German iron and steel industries after the lock-out, which has resulted in offers this week of a wide range of steel products from the Continent, it is difficult to determine. The Birmingham market displays, on the surface, little interest in the new foreign position, and the reduction in prices of steel semis is attributed, in many quarters, to internal weakness. On 'Change in Birmingham to-day—Thursday—continental billets were offered at £5 17s. for 3in. and £5 18s. for 2in. Blooms were quoted £5 9s. and small bars £6. Native makers are endeavouring to maintain the ground they won during the German lock-out, and it is much to be desired that they should. In this connection it might be pointed out that Mr. Arthur Chamberlain, chairman of the directors of Tube Investments, Ltd., recently complained of the quality of British steel for tube manufacture. He gave it as a statement of fact that "the quality of English steel for tube manufacture still leaves a very considerable margin for improvement." His firm, he asserted, much preferred to buy English material, and it was gratifying to know that not for a long time had the British steelmakers been so nearly the equal of their foreign competitors in either price or quality.

Pig Iron.

Consumers of pig iron, using as a weapon the transport rate relief, are gradually but surely beating down the resistance of blast-furnacemen, and forcing them to accept lower prices. Though every endeavour is being made to keep up quotations of Midland brands of pig iron, selling rates have declined. Smelters are anxious to secure specifications to carry them on over the Christmas holidays, for in this branch of industry production proceeds uninterruptedly throughout the holiday break; as Midland foundrymen's requirements to the end of the year are small, some inducement has usually to be offered them to get them to place orders now. Last week's minimum of £2 15s. 6d. no longer represents rock-bottom for Northants No. 3. Sellers are reported to have sold in this district at £2 15s. while, where Midlanders come into competition with Cleveland furnacemen, still lower prices are reported to have been accepted. Derbyshire No. 3 foundry has changed hands at as low as £2 19s., but the majority of the smelters continue to quote £3. Hematite is firm, as North-East coast makers are in a better position. Sellers have asked local consumers as much as £3 11s., but it is considered £3 9s. would be accepted for a substantial order. Furnacemen, ovenmen, and foundrymen continue to argue as to the proportion of the rate relief to which each is entitled, and they appear at the moment to have reached a deadlock. An official declaration on the matter might clear the air, and lead to agreement amongst the rival parties. The difficulties are not being made easier of adjustment by the bold assertion of claims and attitude taken up by some of the parties concerned.

Staffordshire Iron.

There are no new features in the finished iron department. A seasonal slackness has set in and little of moment is anticipated until the New Year. Makers of marked bars are able to maintain prices at £12 per ton, and plant is working fairly regularly, but in the merchant and common bar branches employment is poor and irregular. The Black Country chain and cable and anchor trades have been quiet for a considerable period in consequence of the lull in shipbuilding, and their iron requirements have been small. Crown quality bars continue to range in price from £9 2s. 6d. to £10. Competition in this branch is unabated. Staffordshire common bars used for nut and bolt and fencing manufacture have sold rather better of late, but Belgian suppliers have come forward again this week with attractive offers. Native makers ask £8 12s. 6d. to £8 17s. 6d. for their output, which is some way in advance of continental quotations. Wrought iron gas tube strip sells fairly freely at £8 15s., and some producers are able to get £8 17s. 6d. The tube works in this district are hardly so busy as they were, however.

Galvanised Sheets.

Demand for galvanised sheets is maintained at a moderately good level, but some mills this week state that the requirements of some of the overseas markets have not come up to expectations; at least orders for January delivery have not. There is still time for them to be received before the Christmas break, however. Values are generally upheld, corrugated sheets of 24-gauge being quoted £13 10s. upwards. In special cases a figure slightly lower has, it is said, been accepted, but orders would need to be of considerable magnitude to secure a price concession. It is noteworthy that exports of galvanised sheets to India last year represented 43 per cent. of the total United Kingdom shipments of steel to that country. Midland users of black sheets are taking regular supplies from the mills. Prices are unchanged.

Ironbridge Super Power Station.

An immediate start is to be made with the work of constructing the first section of the new super power station at Ironbridge, at a cost of £700,000. This station is destined to become one of the principal base load generating stations for Central England, though it was at first designed merely to meet the requirements of the authorities within the area of the West Midland Board. The advent of the Central England Electricity scheme has, however, changed that, and the alteration of policy has necessitated the entire redesigning of the station and a reconsideration of the type and capacity of the units to be installed. The station as originally projected was to contain a total of 160,000 kW of plant, chiefly consisting of 20,000 kW sets, but the requirements for Central England of the Central Electricity Board necessitate the installation of very large sets of 50,000 kW capacity, and, according to latest estimates, it is considered that four of them will be required. The first section on which work is about to be begun is for the first of these turbo-generating sets. It is anticipated that this first section will be completed towards the end of 1930 or very early in 1931. The rate at which further extensions will be added depends upon national requirements. The overall cost of the complete station will be nearly £3,000,000.

Prospects of Trade with India.

Midland engineers and iron and steel masters are pleased to learn, on the authority of Mr. T. M. Ainscough, the British Senior Trade Commissioner in India and Ceylon, that there is every likelihood of imports of iron and steel to India continuing to expand in spite of increased production in that country. They hope with sincerity that his expressed confidence that the consumption of steel in India will increase at a very rapid rate *pari passu* with the general development of the country has not been misplaced, and that England's share of the business will increase. Mr. Ainscough reports that the outlook in the import trade for machinery and plant is promising. The British engineering industries, he states, are bound to benefit from the large schemes of railway construction, harbour developments, irrigation and hydro-electric enterprises and bridge building. His advice regarding the changed methods of purchase which will result from the inauguration of the rupee tender system for Government stores is no doubt very sound, and Midland engineering firms will do well to bear in mind the Commissioner's words, *viz.*, "the extent to which British engineering firms will be successful will largely depend on their readiness to adapt their Indian policy to the changed conditions, and to develop a thoroughly efficient sales, technical and service organisation on the spot." An increased demand from India for boilers, prime movers, and electrical plant and for textile machinery, is also anticipated. The advantage accruing from the lower rate of imports duty on British standard steel, Mr. Ainscough says, is considerable, and in many cases ensures the placement of orders for bridge work and structural sections with British works instead of on the Continent.

Birmingham Mechanical Engineers.

The half-yearly meeting of the Birmingham Association of Mechanical Engineers took place on December 7th, when a paper, illustrated by lantern slides, was read by Mr. A. C. W. Aldis, of Birmingham. It contrasted the ordinary mechanical engineer's methods of measuring and shaping metals with optical systems for shaping lenses, and the system of measuring by reference to the wave length of light, with which differences of a millionth of an inch can be detected. An interesting discussion on the unit sight for aeroplanes, the boroscope for detecting flaws in the long hollow forgings for turbines, and methods of production followed.

Junior Institution of Engineers.

The Midland Section of the Junior Institution of Engineers held its annual dinner and ladies' night on Saturday last. The guests included representatives of the Institutions of Civil, Mechanical, Electrical and Structural Engineers. Major J. S. Thompson, President of the Midland Section of the Junior Institution of Engineers, who presided, spoke of the virility and life which area branches of the engineering institutions had given to the parent bodies. The Midland Section of the Junior Institution, he said, was a very live and go-ahead body, and these branches had been a splendid thing for the health of the parent institutions. They were, in fact, the life and soul of the great institutions which had, through them, gone ahead by leaps and bounds.

Waterworks Plant.

The Water Committee of the Wolverhampton Town Council advises the spending of practically £29,000 on waterworks plant. It recommends, subject to the approval of the Ministry of Health, the acceptance of the following tenders:—Hathorn, Davey and Co., Ltd., of Leeds, for the supply and erection of a complete pumping plant, comprising a vertical triple-expansion pumping engine, and a high-speed stand-by pumping set, with necessary auxiliary apparatus, at a price of £23,070 (including a contingency sum of £1000); Babcock and Wilcox, Ltd., of London, for the supply and erection of a complete steam raising plant, comprising two water-tube boilers, superheaters, economiser, chimney, &c., at a price (including a contingency sum of £537) of £5910.

Useful Orders.

Some welcome contracts have been given to Midland firms of late, among them being one for ten bogie passenger underframes for the Egyptian Ministry of Railways, awarded to the Birmingham Railway Carriage and Wagon Company, Ltd. The Eagle Engineering Company, Ltd., of Warwick, has received an order for eighty four-wheeled pneumatic-tired trailers for the Indian Government; twenty-six solid-tired. two-wheeled, 5-ton trailers for Portugal; and seventeen trailers for South Africa.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

The Economics of Electricity Supply.

THE economic factors involved in the supply of electric current were stressed by the deputy chairman of the Manchester Electricity Committee at the last monthly meeting of the City Council, when a discussion took place on the refusal of the Committee to consider a proposal to introduce the slot meter system for domestic consumers of electricity. Alderman Walker said that there was no truth in the suggestion that the Committee had been putting down plant for industrial purposes and charging interest and sinking fund to the domestic user. The factor which determined the price charged for electric current was the length of the period over which the supply was taken, and if, as had been suggested, the minimum rate charged to cover domestic current supply were abolished, the loss would have to be borne by users on whose account it was not incurred, and to this the Electricity Committee was entitled to object. As electricity could not be stored in the same way as gas could be, it had to be generated when it was wanted, and this all added to the cost when a poor or a varying load was in question. It was on the recommendation of the chief electrical engineer that the Committee had decided, while the change from direct to alternating current was being made, not to consider the introduction of the slot meter system. On a vote, the action of the Committee was endorsed.

Lord Melchett on Iron and Steel.

Speaking at a meeting in Manchester, Lord Melchett said that the reasons for the present condition of the iron and steel industry lay in the industry itself and in the industries connnected with it. Unless, he said, the industry was prepared to give binding undertakings to re-establish itself on a modern basis and to disregard personal ambitions or traditions of the past, it could not expect help from the Government, whether in the form of safeguarding or otherwise. Safeguarding duties should not be allowed to become the cloak of inefficiency or stagnation, and those who asked for them should be able to show the capacity to satisfy the needs of the market. They should not be used as a means to extract more money with less effort. In the discussions regarding the safeguarding of the iron and steel industry, one aspect, said Lord Melchett, had, however, been entirely overlooked, and that was that the defence of the country in time of war was unthinkable without a heavy metal industry of large dimensions.

£20.000 Drainage Scheme.

The Lancashire County Council has been urged to prepare a scheme on the lines of a report furnished by Mr. R. W. Eaton, consulting engineer, in conjunction with the Leigh borough engineer, with the object of lowering the drainage level of the "Flash," a large sheet of water resulting from mining subsidences in the area. The scheme, it is estimated, would require a capital sum of £20,000 and an income from a drainage rate of about £400 a year. The County Council and the Leigh Corporation have promised to contribute, and it is expected that contributions will also be made by colliery proprietors, landowners and other affected interests.

Cheap Current.

According to the annual report on the operations of the Bury electricity undertaking during the past year, the capital outlay on the undertaking is £573,907, and the net capital £318,513, and further extensions to the works are proceeding. The average price charged for current during the year was 1·067d., compared with 1d. a unit at which it is hoped to sell electricity under the national supply scheme when it is in full operation.

Textile Machinery for Russia.

It has been officially announced this week that Platt Brothers and Co., Ltd., textile machinists, Oldham, have received an order from Russia for worsted-making machinery. A few months ago the same firm secured an order for £500,000 worth of plant. The present order, although not so large as the previous one, is fairly substantial.

Non-ferrous Metals.

Except for a further advance in spelter and evidence of continued firmness in that section of the market, there has been a general reaction in non-ferrous metals during the past week, and in this, copper, lead and tin in particular, have suffered. The decline in tin since my last report has been very severe, and has brought prices almost back to where they were at the end of October. At the same time, it has not been altogether unexpected, for after the steady advance during the past ten weeks or so a "bearish" movement was to be looked for. Apart from purely speculative influences, however, the statistical position cannot be regarded as strong, for if consumption prospects appear to be rather brighter than they have been, production of the metal tends to expand, and it is no secret that stocks in this country during the past few weeks have been on the increase. On balance for the week, tin values are lower to the extent of £11 to £12 a ton. Quieter conditions have obtained in the copper section, and here again, after a steady and virtually uninterrupted advance, quotations for the metal are back to where they were at the end of October. The demand for lead has been on a smaller scale, and the effect on prices has been that the whole of the previous week's advance has been lost. As has already been indicated, spelter has been the sole exception to the general weakness, and in this section a new high level has been reached. The advance, however, appears to be due to "bullish" hopes of more effective output restriction rather than to any particular feature about the demand.

Iron and Steel.

Absence of anything resembling activity in the iron and steel markets continues and traders recognise the fact that for the next month or so extremely quiet conditions are likely to rule. In pig iron buying has been restricted to odd parcels, but prices are fairly steady, the rise in blast-furnace coke being a factor which is likely to counterbalance any weakness that otherwise might develop. Sales of Derbyshire iron this week have been on the basis of 67s. 9d. per ton, delivered Manchester or equal, with Staffordshire makes at about 6d. less, whilst Middlesbrough iron continues to be quoted at 79s., Scotch at 87s. 6d. to 90s., and hematite at 82s. Local constructional engineers have reason to hope for better conditions with the turn of the year, but in the meantime their demands upon the steel market are light. Both general and boiler plates are also in poor inquiry, although bars are still in relatively good request. Sections are quoted at £7 17s. 6d., small bars at £8 to £8 2s. 6d., according to quantity, large bars at £8 17s. 6d., tank plates at £8 12s. 6d., and boiler plates at £9 15s. for acid qualities and £9 10s. for basic. Interest in imported steel products is at a low ebb, and a not unexpected weakness in this section of the market has developed, a factor which tends to keep buyers off. Continental works are now quoting sheet bars for delivery to works in the Lancashire area at about £5 16s. per ton, with billets at £5 14s., Siemens plates at £8, Thomas plates at £7 10s., angles at £6 16s., joists at £6 5s. to £6 6s., wire rods at £6 17s. 6d., and steel bars at about £7 5s.

BARROW-IN-FURNESS.

Hematites.

Conditions in the hematite pig iron trade of this district show no material change this week. There is a steady run of business, and the whole of the make of the eleven furnaces operating is being disposed of, while some sales are taking place from store. It is hoped that in the early part of the New Year these stocks, which accumulated during the slack time last spring, will be entirely cleared. Local wants are moderate, with the Barrow Steel Works idle, but Workington steel makers are taking fairly good supplies of metal. Overseas business is quiet, but a cargo of pig iron has been sent from Barrow to the United States. Special iron is in quiet call.

Iron Ore.

The demand for iron ore is largely local, and not much foreign ore is coming in at present. Exports of ore are particularly quiet.

Steel.

In the steel trade there is continued activity at Workington, the chief output being of steel rails for home and overseas, but the demand is slow all round, and for that reason the plant at Barrow remains idle, the only activity being the rolling of steel hoops, mostly for overseas buyers and the demand is steady. Billets are dull. There is a fair call for castings.

Fuel.

The demand for fuel, both coal and coke, is steady. East Coast coke is being largely used, with Cumberland qualities in fair demand.

Shipbuilding and Engineering.

The shipbuilding and engineering trades are well employed in most departments, and progress is being made at Barrow in the fitting out of a submarine depôt ship and a fleet repair ship, both for the British Navy. The demand for new tonnage is very quiet.

SHEFFIELD.

(From our own Correspondent.)

Position of Heavy Trades.

THE closing weeks of the year find a good deal of activity, some of it as a result of genuinely increased business, and some merely a rush to get orders through before the start of the Christmas holidays. Trade in some important branches is certainly brisk, and the prospects are reasonably good for the start of the New Year, but taking the general iron, steel and engineering conditions in the city and district, movements lack that vim and confidence which one would like to see. At the same time there is a feeling of optimism abroad among the leading industrialists, and one sound cause for it is the manner in which large engineering orders have been placed during the last month or so. Some good contracts for heavy finished steel to be delivered in the New Year have been received in the city, and the brighter conditions in engineering centres outside, which look to Sheffield for their supplies of material, suggest, particularly in view of the low stocks on which works have been running for some time, that the improvement should be passed on to Sheffield and Rotherham in the very near future. One branch that is already doing well is that devoted to the production and rolling of soft basic steel. The call for that material has been very good for some time, and the general demand gives every indication of continuing. Ten of the fourteen large open-hearth furnaces at Templeborough are working, and making allowances for furnaces under repair, the plant may be said to be working at full capacity. Acid steel is in comparatively poor demand, and there is still no sign of any improvement in the call for railway materials. Ordinary railway steel is being irregularly bought, and, in consequence, a good deal of plant is standing idle, whilst there is similar slackness in the departments manufacturing rolling stock and parts. It is Colonial and South American railways rather than the British ones which are accounting for the greater part of the activity.

The Iron Market.

The recently increased output of pig iron does not seem to have met with a correspondingly advanced demand in the buying market. Consumption, in fact, seems to be about on the same level that has been the rule for some time. The light foundries have been less busy, but to set against that is the fact that the engineering foundries are booking more work. Cast iron pipes are a good line at present. Some weakness is noticeable in the pig iron market as the result of supplies being fairly free. The makers of pig iron are faced with the prospect of increased cost of production as a result of the decision of the Blast-Furnace Coke Sales Association to increase immediately the price of coke by 1s. a ton, the new minimum being 14s. 6d. as against 13s. 6d. per ton at the ovens. For a considerable time the coke makers have had to pay top prices for good quality slacks, owing to the marked shortage following the poor working of the pits, and they are evidently now passing on some of the burden to the pig iron maker.

Steel Output Figures.

The figures are now available for the outputs of steel in Lincolnshire and Sheffield during October. The Lincolnshire total was 53,400 tons, all being basic, which is 9000 tons more than in September and 10,000 tons more than in October last year. Lincolnshire also produced 65,800 tons of pig iron, compared with 62,800 tons in the corresponding month a year ago. The output of steel in Sheffield in October was 102,900 tons, compared with 91,200 tons in September and 90,500 tons in October last year. The increase was entirely in the basic section, the output of acid material having declined.

Steel Railway Sleepers.

Although Sheffield naturally welcomes any movement encouraging the greater use of steel, the latest suggestion for the more general adoption of steel sleepers for railways in this country will not directly benefit works in the city and district, as they do not make the class of material required—acid Bessemer steel.

Cutlery and Plate.

The seasonal trade in the cutlery and plate trades is now practically at an end, though a few belated orders keep arriving. In consequence, many of the local factories have entered on a quiet spell which will doubtless continue in the usual way well into the New Year. All the works, however, are not affected, as a number of very large contracts for good quality cutlery and plate are being executed in the city. The season has been a very good one for the makers of cases and cabinets of cutlery, and all circumstances considered there has been quite a good sale of the more expensive cabinets.

Lincoln Firm's New Product.

The directors of Clayton and Shuttleworth, Ltd., of Lincoln, attribute their trading loss on the year of £14,766 almost entirely to the fact that, although the company obtained its share of available orders during the year, it was not possible to keep the works fully employed. In order to cope with the lack of demand for the company's staple agricultural products, the directors have been engaged during the year upon the production and development of a new harvester machine—the Clayton harvester thrasher. It is expected that this new product will bring considerable orders from markets which have been lost to the company since 1914.

Colliery Matters.

There is news this week of one Yorkshire pit closing and another one reopening. West Ardsley Collieries, near Leeds, owned by the Yorkshire Iron and Coal Company, have closed down, and it is stated that, although there is plenty of coal in the seams, it cannot be got at a profit, the loss on the pits having been over £500 a week for some months. Besides the pits being closed, the coke ovens and by-product plants are affected, and between 800 and 900 men and boys are thrown out of work. The same company is also closing down its pit at Scunthorpe, and its ironworks at East Ardsley. To set against this is the good news to hand concerning the Prince of Wales Colliery, Pontefract, which has been taken over by new proprietors. The pit has now been reopened after nearly three months' suspension of work. The Haigh Moor seam, which has been closed for nine months, is being prepared for reopening, and it is expected that coal getting will commence very shortly. Considerable work has still to be done in the completion of the shaft and the driving of headings in the new Beeston seam, but it is hoped that it will be ready for coal-getting operations by about next March.

NORTH OF ENGLAND.

(From our own Correspondent.)

No More Foreign Steel.

A NORTHERN industrial anomaly of considerable interest and importance has been removed by the decision of the Furness Shipbuilding Company, Ltd., Haverton Hill-on-Tees, to become subscribers to the steel manufacturers' rebate scheme. Inaugurated over a year ago, the rebate scheme was designed to counteract the then severe havoc wrought in the British steel trade by continental competition. It established a system of rebates or special price concessions promised by British steel manufacturers to all British shipbuilding and engineering firms prepared to give a guarantee that they would buy and use British material only. The vast majority of shipbuilding and engineering firms gradually agreed to give this guarantee, and thereby qualified for the rebates. For some considerable time the only exception in the North of England has been the Furness Shipbuilding Company, which, however, is frankly believed to have found employment for Tees-side men that would not otherwise have been available, by building ships in a time of fierce competition, with the commercially cheaper continental materials. Recently the margin between British and continental steel quotations has narrowed very appreciably as a result of increasing production costs on the Continent. From showing an advantage as regards price, the purchase of foreign steel for shipbuilding in Britain has now become a handicap—especially in regard to delayed deliveries. The Furness Shipbuilding Company is the last firm in the North of England to dispense with foreign materials, and is actually one of the last in England. Incidentally this development more strongly establishes the English Steel Manufacturers' rebate scheme.

Cleveland Iron Trade.

The near approach of the Christmas and New Year holidays invariably brings a temporary quieting effect on the iron and steel markets. This year is likely to be no exception, although the amount of inquiry and actual business afoot remains very encouraging. The output of Cleveland pig iron continues to be absorbed largely by manufacturers' own requirements, but there is a steady demand for the surplus. Stocks have been depleted by 60,000 tons in the past three months, and are now at a very low level. The cheaper carriage rates for raw materials mark a step forward in the production and sale of iron at remunerative prices, but more particularly in the case of those firms controlling their own sources of raw materials. Prices are firm, No. 1 Cleveland foundry iron being 68s. 6d.; No. 3 G.M.B., 66s.; No. 4 foundry, 65s.; and No. 4 forge, 64s. 6d.

Hematite Pig Iron.

Steady moderate requirements of home and continental consumers promptly take up the limited make of East Coast hematite pig iron, and as stocks have all but vanished, scarcity is somewhat acute. Soon after the Christmas holidays the Ayresome Ironworks of Gjers, Mills and Co., Ltd., Middlesbrough, are to be restarted, and other hematite producing firms may increase their make. While manufacturers have no arrangement as to fixed prices, market rates may be said to be based on ordinary qualities at 71s.

Ironmaking Materials.

Foreign ore merchants are taking a very firm stand, and are assisted in their attitude by the strong state of the freight market. Consumers of imported ore are as disinclined as ever to pay the prices asked, but sellers declare that expiring contracts will not be renewed at anything below current rates, which are based on best Rubio at fully 22s. 6d. c.i.f. Tees. Rather more movement in the buying of blast-furnace coke is noticeable, but local users are still unwilling to negotiate for large supplies. Good average qualities keep round about 17s. delivered at the works in this area.

Manufactured Iron and Steel.

Manufactured iron and steel trade prospects are distinctly brighter, and there is likely to be a much heavier

output in the near future. Shipbuilding specifications promise to be freely distributed. The outlook for the producers of railway material is also much improved. Demand for steel for constructional engineering is expected to expand, and sheet manufacturers have contracts sufficient to keep plant running at almost full capacity for some months. Steel for engineering purposes is still arriving in very limited quantities from the Continent, but, on the whole, continental competitors have lost ground heavily in the past few months.

Shipbuilding.

There are still a number of inquiries circulating for new vessels. North-East Coast shipyards will start the New Year with a good budget of mercantile orders. There will be empty yards here and there, but other yards will have every berth occupied. It is a remarkable change from what was a very dull outlook only a few months ago. In the course of the last two months about eighty cargo boats, aggregating nearly half-a-million tons, have been ordered.

Orders for Vessels.

The Northumberland Shipbuilding Company (1927), Ltd., Howdon-on-Tyne, has met with further success in regard to securing new contracts for vessels. Last week the firm booked an order for three vessels, and this week orders for other three vessels for British owners have been secured. Hawthorn, Leslie and Co., Ltd., Hebburn-on-Tyne, have signed a contract to build a cargo vessel of 8600 tons deadweight for Tyneside owners.

The Coal Trade.

The Northern coal trade position is quite encouraging both to owners and operators in the export section. The prompt position is fully relieved by the abundant tonnage arrivals at the coal shipping centres. Loading turns are full, and on the Tyne the position is so satisfactory that several boats under a recent agreement are being diverted to Tyne Dock for loading. The output is accordingly being rapidly cleared, and everything is now pointing to a steady squeeze for supplies until after the turn of the year. Northumberland steams for three weeks ahead are very scarce, and whilst late prices are quoted at maximum figures, many fitters state that if they had supplies available they would want fully sixpence advance in price. Best Northumberland steams are quoted at 14s. 3d. and seconds at 13s. 3d. to 13s. 6d. Steam smalls are doing much better than of late, and prices are steadier at 9s. 3d. to 9s. 6d. Durham steams are more favourably placed for tonnage, and are firm in price. The cold spell has helped the Durham gas fuel trade considerably, and best brands are firmer at 14s. 9d. and secondary classes steadier at 13s. 3d. to 13s. 6d. Coking coals and bunkers are without much change. The general tone of the coke market rules firm, and for this month's supplies buyers are having to pay 3d. per ton advance. Gas coke is in good demand, and is firmly quoted at 18s. 6d. to 19s. 6d. Patent oven cokes are moving more freely, some makers being fully sold to the end of the month. Stocks are moderate at 18s. 6d. to 19s. Beehive cokes are steady, and specials firm at 23s. 6d. to 28s. 6d.

SCOTLAND.

(From our own Correspondent.)

Steel and Iron.

THE settlement of the trouble in the Ruhr has put an end to the hope that local makers might derive some substantial benefit from a continuance of the lock-out in that district. Some time must necessarily elapse before production in the affected area becomes normal, but it is considered unlikely that any more business will be diverted to this country or to Scottish makers. It is questionable if local producers, as a whole, have benefited to any extent by the Ruhr lock-out, as the volume of business during the past four weeks or so has shown little, if any, advance on the previous turnover. Meanwhile, hopes are entertained that the improvement in shipbuilding contracts will continue. Rumours are busy which, if they materialise, should make the outlook considerably brighter. Already, heavy steel makers have better demands for shipbuilding material, while the export demand also shows some improvement. Steel sheet makers are comparatively busy. Black and galvanised descriptions are generally firm, and prices of some gauges are inclined to stiffen. The recent demand for re-rolled steel has barely been maintained, though the output is still considerable. Makers so far have been able to utilise their stocks of raw materials, but may now be forced to draw on home supplies until such time as fresh deliveries from the Continent can be arranged. Prices of re-rolled steel remain firm and round about £7 15s. per ton home or export. Prospects in the bar iron trade have not improved, and the demand is very low. Pig iron is similarly placed and the depression in this industry is borne out by the damping down of three furnaces at Gartsherrie, leaving only twenty furnaces in blast in Scotland, compared with about eighty in pre-war days.

Exports and Imports.

During the past week 7400 tons of iron ore and 3000 tons of steel and iron were unloaded at Glasgow Harbour. During the same period 6600 tons of steel and iron and 1157 tons of pig iron were shipped abroad.

Coal.

An improvement has taken place in the shipping department of the Scottish coal trade during the past few days, owing to the arrivals of steamers delayed by the recent stormy weather. Collieries had been compelled in some instances to curtail outputs to avoid congestion, and some were considering making price reductions in order to lighten stocks. The necessity for such action has now disappeared, and firm conditions rule again. West of Scotland ells and splints are well bought up. Fifeshire best steams are fully booked until the end of the month, and Lothians best steams are only obtainable in small lots for early shipment. Second qualities of Fife and Lothians steams are fairly active also. Washed materials are somewhat irregular. Treble nuts are strong in all districts, but double nuts and smaller sizes are somewhat erratic. Aggregate shipments for the week amounted to 247,300 tons against 213,652 tons in the preceding week and 269,434 tons in the same week last year. Home demands for all classes of fuel are still well under normal and collieries continue to experience difficulty in obtaining the increased prices intimated some weeks ago.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

As anticipated, considerable activity prevails in the shipment of coal from this district, and is likely to continue to the end of the year. The fact is that for all practical purposes this is a three weeks' month, inasmuch as the Christmas holidays will make such a serious break into the last week of the month that exporters must make every effort to effect their shipments before Christmas. The consequence is that there has been increased activity in the chartering of steamers that can give early readiness, and the docks are well supplied. At the end of last week there were twenty-eight idle tipping appliances at the various docks, and only four vessels waiting, but on Monday there were fourteen steamers waiting as against twelve idle tipping appliances. On Wednesday the number of steamers waiting was exactly equal to the number of appliances not in use, and there is a fair amount of tonnage due, so that the collieries are having a busier time than they have had for several months past. In fact, the position with many concerns is that they are so well placed for prompt orders and for tonnage that they have advanced their prices for any small parcels of coal which they may have to spare. While the immediate position is so good, it cannot be said definitely that these satisfactory conditions are likely to continue into the New Year. There is no doubt that a fair amount of business has been done ahead, but general operations for next month cannot be said to be active. There are inquiries for the first half of next year, and even for the whole of the year, but they are not considerable. The Portuguese State Railways have bought 50,000 tons of coals for shipment during practically the first three months of 1929, while the Spanish Naval Administration has purchased 9000 tons of superior Admiralty large coals for prompt delivery.

Coalfield Items.

At the time of writing no definite decision had been announced regarding the holiday arrangements to operate in the South Wales coalfield at Christmas time; but it is reported that consideration may be given to the question whether the whole of Christmas week should not be a stop week, as in the case of the tin-plate industry. As things are the miners are entitled to three days' holiday, and this means that production for the week will not be much more than 25 per cent. of the normal. Most miners, however, have had such a bad time that every consideration must be given to their interests, though there is this about it that after a stoppage of a full week there would be the prospect of more regular work immediately following, so that on the whole they would not lose. The report is also current, though nothing official has as yet transpired, that South Wales coalowners intend to approach as a body royalty owners for the purpose of securing from them a reduction of royalties and wayleaves. On the average, these items are higher in this district than in any other coalfield in the country, and recently have amounted to nearly 9d. per ton on the reduced output. With regard to wages in the coalfield, this matter came up for consideration at a meeting of the Conciliation Board at Cardiff on Monday following upon the application of the coalowners and the representatives of the workmen for a revision of the agreement as and from January 1st, to which reference has already been made. As was expected, the parties failed to agree, and consequently the question has been referred to the independent chairman. An adjourned meeting of the Board will be held on Tuesday, the 18th inst., when Sir Francis Taylor will preside.

LATER.

The official holidays in the South Wales coalfield have been fixed as three days, viz., Tuesday, Wednesday and Thursday. As regards work at the docks, it has been agreed that two short shifts shall be worked on Monday, 24th inst.; Christmas Day and Wednesday will be holidays, while on Thursday two short shifts will again be worked.

Docks Facilities.

The curtailment of docks facilities in this district continues to absorb a good deal of interest. The Great Western Railway Company is applying for powers to close the Newport Town Dock, and this is meeting with no little amount of opposition on the part of the Newport trading community, which naturally fears that this step will mean that a certain amount of its trade will go to other ports in this district. In a letter to Mr. Reginald Clarry, who has taken the matter up, Sir Felix Pole states that since the war and for some years previously, the maintenance of the facilities at Newport has involved an increasing annual loss, and that such loss now amounts to approximately £10,000 a year. Moreover, the company is faced with the necessity of effecting heavy repairs to the dock and its appliances, and the renewal at an early date of the existing lock gates. Sir Felix adds that there is no intention whatever on the part of the company to take any action calculated to prejudice the position of Newport, and it will continue as in the past to provide facilities for all traffic which is offered. With regard to the reduction of appliances at Cardiff, the position is that, following upon negotiations, the company decided to close three tips at the East Dock at Cardiff and three at Barry. The three tips at the East Dock at Cardiff were closed on Monday and those at Barry will be closed at the end of this week. This, of course, has meant the displacement of a number of workmen, but some have been transferred, and in the case of the tippers they do not suffer, as they will share in the work of the men at other tips. The Great Western Railway Company made the proposal to the workmen that if they were prepared to accept a reduction of 2½ per cent. in their wages, then the tips at Cardiff and Barry would be kept working. Mass meetings were held at the end of last week, when the tippers at Cardiff decided to accept the cut in wages on the conditions offered, but the men at Penarth and Barry decided to refuse the terms. The position was therefore somewhat awkward, but as the acceptance of the whole of the workmen was not obtainable, the G.W.R. Company's decision to close the three tips in the East Dock, Cardiff, and three at Barry operates.

Labour Control at Docks.

Sir Felix Pole delivered an interesting speech at a meeting of the Cardiff Business Club on Friday last, among the subjects with which he dealt being that of the control of the trimming at South Wales docks. He criticised the present system of dual control over men employed at the docks, and expressed the view that no organisation could be satisfactory that was based on divided control. He pointed out that at present the G.W.R. Company controlled the tippers, while the trimmers were under the control of others, viz., a Control Board, composed of representatives of the shipowners and the trimmers, while other interests, including the Great Western Railway and the exporters, had representation *ex officio*. This question has very promptly been taken up, though it has been discussed before. There was a meeting of the South Wales Coal Shipment Advisory Committee at Cardiff on Monday, when it was decided to appoint a sub-committee to examine the whole subject in detail. Attention was also drawn to the reported agreement on the North-East Coast, whereby the tippers and trimmers would work until 10 p.m. on Saturdays, and the Committee unanimously resolved that representations should be made to the Trimming Board and to the Great Western Railway Company that a similar arrangement should be made in South Wales.

Current Business.

Most collieries are working much better and finding a ready outlet for all their available coal. The position is quite good, and will continue so up to the holidays. Most colliery salesmen have no coal to offer for prompt loading, and in the case of any small parcels which can be spared they are asking rather higher prices. Sized qualities are especially firm, and dry coals have a good market. Coke keeps steady, but patent fuel remains without any notable improvement. Pitwood is a shade steadier than a week ago. The members of the Cardiff and Bristol Channel Pitwood Importers' Association have decided that as from January 1st the terms of credit granted by pitwood importers on current sales of pitwood, and also in respect of future contracts, will be reduced from fourteen days to seven days, or cash less ½ per cent., at sellers' option.

LAUNCHES AND TRIAL TRIPS.

IRANIA, single-screw motor driven oil tanker; built by Blythswood Shipbuilding Company, Ltd., Scotstoun, to the order of Iranium Tanker Company, Ltd.; dimensions, 300ft. by 44ft. by 20ft.; oil in bulk. Engines, two-stroke double-acting oil engines; constructed by Richardsons, Westgarth and Co., Ltd., Hartlepool; launch, November 13th.

OIL TANK MOTOR SHIP; built by Swan, Hunter and Wigham Richardson, Ltd.; dimensions, 450ft. by 60ft. 11¾in. by 32ft. 3in.; 11,000 tons deadweight. Engines, single-screw Wallsend-Sulzer two-stroke cycle marine oil engine; constructed by Wallsend Slipway and Engineering Company, Ltd.; launch, November 28th.

SIR WILLIAM HOY, steel twin-screw super tug and salvage vessel; built by Sir W. G. Armstrong, Whitworth and Co., Ltd., to the order of the South African Railways and Harbour Administration; dimensions, 180ft. by 34ft. 6in. by 17ft. 6in.; for dock and salvage work. Engines, triple-expansion, pressure 210 lb. per square inch; constructed by the builders; launch, November 28th.

A BOILERMAKERS' CENTENARY.—Surely the most remarkable and the most delightful centenary celebrations that have ever been held! Roast turkey and marrons glacées, paper caps; plum puddings flaming in subdued light; dances between the courses and dances after the cources; "Auld Lang Syne" and "For they are jolly good fellows"—and not a single speech the evening through. Thus it was that in real Christmas mood the John Thompson Associated Companies celebrated at the Cecil on Wednesday last the foundation of the parent company just a hundred years ago. May they flourish for another hundred years, and may we be there to rejoice with them in like way again

INSTITUTION OF MECHANICAL ENGINEERS.—The annual dinner of the North-Western Branch of the Institution of Mechanical Engineers was held at the Engineers' Club, Manchester, on Thursday, December 6th, and was well attended, the guests including the President, Mr. Richard W. Allen, members of the Steam Nozzles Research Committee, the Lord Mayor of Manchester, and the Chairmen of the local branches of the other engineering institutions. The toast of "The Institution of Mechanical Engineers" was proposed by Mr. S. H. Morgan, M.C., M. Inst. C.E., Chairman of the Institution of Civil Engineers, Manchester and District Association, and was responded to by the President of the Institution, who congratulated the branch upon the selection of one of its members, Mr. D. Adamson, as the President next year. Mr. Allen made a very sympathetic appeal to the members on behalf of the Benevolent Fund. The toast of "Our Guests" was proposed by Mr. Daniel Adamson, who said the summer meeting next year was practically fixed for Manchester. All that was now required was the assurance that the civic authorities would co-operate to ensure the success of the meeting. In response to the toast the Lord Mayor of Manchester, Councillor George Westcott, who is an architect by profession, announced that he would "welcome the Institution to Manchester with both hands," and expressed the hope that that city would be honoured by next year's summer meeting. Professor A. L. Mellanby also replied on behalf of the guests in a humorous speech. The toast of "The Chairman," Professor W. Watkinson, M.Eng., was proposed by Mr. H. F. Massey, and was acknowledged in a few well-chosen words by the Chairman.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	17/- to 19/-
(1) Spanish	21/-
(1) N. African	21/-
N.E COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	22/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 14 0	—
No. 1 Foundry	3 15 0 to 3 16 0	—
No. 3 Foundry	3 11 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 11 0	3 11 0
No. 1	3 12 0	3 12 0
Cleveland—		
No. 1	3 8 6	3 8 6
Silicious Iron	3 8 6	3 8 6
No. 3 G.M.B.	3 6 0	3 6 0
No. 4 Foundry	3 5 0	3 5 0
No. 4 Forge	3 4 6	3 4 6
Mottled	3 4 0	3 4 0
White	3 4 0	3 4 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
„ „ Foundry	3 2 6	—
(3) Northampton—		
Foundry No. 3	2 15 0 to 2 16 0	—
Forge	2 11 6 to 2 13 6	—
(3) Derbyshire—		
No. 3 Foundry	2 19 0 to 3 0 0	—
Forge	2 15 0 to 2 18 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 0 6	—
No. 4 Forge	2 17 6	—
Basic	3 0 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 0 0 (a) / 4 2 6 (b) / 4 5 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	10 5 0	—
Best Bars	10 15 0	—
Double Best Bars	11 5 0	—
Treble Best Bars	11 15 0	—
LANCS.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	13 0 0	—
S. YORKS.—		
Crown Bars	10 10 0	—
Best Bars	11 0 0	—
Hoops	12 10 0	—
MIDLANDS—		
Crown Bars	9 2 6 to 10 0 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 12 6 to 8 17 6	—
Gas Tube Strip	10 15 0 to 10 17 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ¾in. and up	8 7 6	7 12 6
Sections	7 17 6	7 2 6
Steel Sheets, ¼in.	8 15 0	8 12 6
Sheets (Gal.Cor. 24 B.G)	13 10 0	13 12 6 to 13 15 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 7 6	—
Angles	7 17 6	—
Boiler Plates	12 15 0	—
Joists	7 17 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	7 12 6	—
Soft Billets	6 15 0	—
N.W COAST—		
BARROW—		
Heavy Rails	8 0 0	—
Light Rails	8 5 0 to 8 10 0	—
Billets	6 15 0 to 9 15 0	—
MANCHESTER—		
Bars (Round)	8 17 6	—
„ (Small Round)	8 0 0 to 8 2 6	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 12 6 to 8 17 6	—
„ (Lancs. Boiler)	9 10 0 to 9 15 0	—
SHEFFIELD—		
Siemens Acid Billets	9 0 0	—
Hard Basic	8 12 6	—
Intermediate Basic	8 17 6 and 7 12 6	—
Soft Basic	8 12 6	—
Hoops	9 0 0	—
Soft Wire Rods	7 12 6	—
MIDLANDS		
Small Rolled Bars	7 15 0 to 8 0 0	—
Billets and Sheet Bars	6 5 0 to 6 7 6	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 10 0 to 13 12 6	—
Angles	7 17 6	—
Joists	7 17 6	—
Tees	8 17 6	—
Bridge and Tank Plates	8 12 6	—
Boiler Plates	11 0 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	18/- to 18/1½
Block Tin (cash)	227 10 0
„ (three months)	225 0 0
Copper (cash)	68 2 6
„ (three months)	68 8 9
Spanish Lead (cash)	21 2 6
„ (three months)	21 12 6
Spelter (cash)	26 12 6
„ (three months)	25 15 0
MANCHESTER—	
Copper, Best Selected Ingots	74 2 6
„ Electrolytic	75 10 0
„ Strong Sheets	98 0 0
„ Tubes (Basis Price), lb.	0 1 1½
Brass Tubes (Basis Price), lb.	0 1 0½
„ Condenser, lb.	0 1 2½
Lead, English	22 15 0
„ Foreign	21 15 0
Spelter	26 17 6
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 10 0	7/6
„ „ 6 p.c. to 8 p.c.	£20 10 0	7/-
„ „ 8 p.c. to 10 p.c.	£20 0 0	6/-
„ „ Specially refined		
„ „ Max. 2 p.c. carbon	£33 0 0	12/-
„ „ „ 1 p.c. carbon	£37 0 0	15/-
„ „ „ 0·70 p.c. carbon	£42 0 0	17/-
„ „ „ carbon free	1/- per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£13 15 0 for home; £13 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/- per unit	
„ „ 75 p.c.	£19 0 0 scale 6/- per unit	
„ Vanadium	14/- per lb.	
„ Molybdenum	4/3 per lb.	
„ Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£170 to £175	
Ferro-Cobalt	9/- per lb.	

FUELS.

SCOTLAND.
(*Prices not stable.*)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	14/-
„ „ Ell	16/-
„ „ Splint	16/3 to 17/-
„ „ Trebles	14/9 to 15/6
„ „ Doubles	13/9 to 14/-
„ „ Singles	12/6 to 12/9
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/6
„ „ Jewel	16/6
„ „ Trebles	16/-
FIFESHIRE—	
f.o.b. Methil or Burntisland—Steam	12/9 to 13/6
Screened Navigation	18/-
Trebles	15/6 to 16/6
Doubles	13/6 to 13/9
Singles	12/9
LOTHIANS—	
(f.o.b. Leith)—Best Steam	13/6
Secondary Steam	13/-
Trebles	15/3 to 15/6
Doubles	13/6
Singles	12/9

ENGLAND.

(8) N.W. COAST—	
Steams	23/-
Household	38/6 to 51/-
Coke	22/-
NORTHUMBERLAND—	
Best Steams	14/3
Second Steams	13/- to 13/6
Steam Smalls	9/-
Unscreened	11/9 to 12/-
Household	21/- to 27/-
DURHAM—	
Best Gas	14/9
Second	13/3 to 13/6
Household	21/- to 27/-
Foundry Coke	18/6 to 19/6

SHEFFIELD—	Inland.	
Best Hand-picked Branch	26/- to 27/6	—
Derbyshire Best Bright House	23/- to 24/6	—
Best House Coal	20/6 to 21/6	—
Screened House Coal	17/- to 18/-	—
„ „ Nuts	16/- to 18/-	—
Yorkshire Hards	14/6 to 16/-	—
Derbyshire Hards	14/6 to 16/-	—
Rough Slacks	8/6 to 9/6	—
Nutty Slacks	4/6 to 6/-	—
Smalls	3/6 to 4/-	—
Blast-furnace Coke (Inland)	14/6 at ovens	—
Furnace and Foundry Coke (Export), f.o.b.		19/- to 19/6

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	19/3 to 19/6
Second Smokeless Large	18/- to 19/3
Best Dry Large	18/6 to 19/-
Ordinary Dry Large	17/6 to 18/-
Best Black Vein Large	17/9 to 18/-
Western Valley Large	17/3 to 17/6
Best Eastern Valley Large	17/- to 17/3
Ordinary Eastern Valley Large	16/6 to 16/9
Best Steam Smalls	12/6 to 13/-
Ordinary Smalls	10/6 to 12/-
Washed Nuts	18/- to 24/-
No. 3 Rhondda Large	19/6 to 20/-
„ „ Smalls	14/- to 14/6
No. 2 „ Large	16/- to 16/6
„ „ Through	14/6 to 15/6
„ „ Smalls	11/- to 12/-
Foundry Coke (export)	27/- to 37/-
Furnace Coke (export)	19/- to 21/-
Patent Fuel	20/- to 21/6
Pitwood (ex ship)	27/6 to 27/9
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	34/- to 35/6
Seconds	24/6 to 28/6
Red Vein	22/- to 27/-
Machine-made Cobbles	40/- to 43/6
Nuts	36/- to 43/6
Beans	23/6 to 25/-
Peas	17/3 to 18/-
Breaker Duff	8/- to 8/6
Rubbly Culm	9/6 to 9/9
Steam Coals:	
Large	17/6 to 18/6
Seconds	16/- to 17/-
Smalls	10/- to 12/6
Cargo Through	15/- to 16/-

(1) Delivered. (2) Net Makers' Works. (3) f.o.t. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate 12/6 joists and 10/- all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our own Correspondent in Paris.)

Merchant Marine.

THE situation of the merchant marine has long been regarded as so unsatisfactory that the necessity of the State coming to its aid was again urged during the debate on the Budget Estimates in the Chamber of Deputies. The State has already done all that is possible in the way of instituting a system of credits to enable shipowners to order new vessels, and, probably in no country has more been accomplished, by increasing the capacity and improving the equipment of ports, to provide facilities for carrying on maritime traffic. The merchant marine has certainly made notable progress, for notwithstanding the fall in tonnage after the war from 2,300,000 tons to 1,400,000, it rapidly rose to 3,800,000, mainly with the aid of vessels surrendered by Germany. At that time France occupied the third position as regards tonnage, but from 1922 she has been falling behind as the result of the activity of other countries, until now she holds only the sixth rank. This is due to the difficulty experienced by shipowners in competing with foreign bottoms. Since the war the number of shipyards has increased from fourteen to nineteen, having a total of ninety-one stocks. At the same time, the tonnage constructed has diminished by one-half, and efforts are now being made to provide work for the shipyards by encouraging the construction of vessels upon the most economical lines, particularly by the use of internal combustion engines, whereby it will be possible to reduce the number of hands and increase the cargo space. Since the system of credits to shipowners was instituted, orders have been placed for 132,000 tons, which is nearly the normal amount required for the renewal of the fleet. To that extent, therefore, the situation has improved, but the French mercantile marine is still more seriously handicapped than the marines of other countries by heavy charges, not the least being those involved by the application of the eight hours' working day. In the Chamber of Deputies, it was declared that there was no intention to suppress this social legislation, but that efforts would be made to get the eight hours' working day adopted by the marines of other countries. Nevertheless, so many reservations are provided in the Eight Hours Act that it is not really effective, although its operations are irksome and add considerably to the charges of shipowners. Another drawback is the very small percentage of foreign hands that can be carried on French vessels, and it is a serious impediment at a time when there is a steady falling off in the number of apprentices to the seafaring profession.

Coal.

Alike in the north of France, in the Saar, and the Ruhr, there is a tendency for coal prices to harden, and, finding that there is nothing to gain by pursuing a policy of price cutting, especially in view of the continual struggle over the question of wages, coalowners are accepting the inevitable, and are no longer disposed to make ruinous sacrifices in order to compete with British coal in the Centre and south-west. In the case of the Saar coalfields, which are worked by a French State Administration and supply this country with 5,000,000 tons of coal a year to the detriment of the British industry, it is found no longer possible to send consignments to the Centre in competition with British coal. Overland freights are all against the Saar fuel. It is for that reason that efforts are being made to push forward the completion of the northern canal system, and particularly the construction of the Nord Canal to Paris. A feature at the moment is the process of concentration which is taking place everywhere, as was done in the case of the collieries in the north of France after the reconstruction, and it is being carried still further in Belgium where negotiations are nearly completed for a concentration of interests for the sale of coal and coke. After passing through a lean period, when prices suffered from over-production, coalowners now aim at organising the industry on a sound profit-making basis.

Railway Signals.

The number of railway accidents owing to inobservance of signals, suggested that there was room for improvement in the signalling system employed on the French railways, and many tests have been carried out during the past few years with different signalling methods, one result being the adoption of electric signalling with lights on a black panel on the suburban lines of the State railways. The Minister of Public Works has now decided that the railways are to be equipped with a signalling system composed of green, red, and orange-tinted lights, the last replacing the violet lights now usually employed. The work will be carried out gradually in order to avoid risks during the period of transformation. While it is claimed that the electric system on the State Paris suburban lines is more satisfactory in foggy weather, there is nothing yet really effective, and it was probably through the signals being invisible in a fog that a passenger train ran into a goods train at the station of Sundhoffen, near Colmar, while the latter was crossing the main line. The driver of one of the trains was killed and a large number of passengers injured, several of them dangerously.

Port Improvements.

With the aid of German reparations a considerable amount of work is being carried out for the enlargement and equipment of ports, and at Boulogne it is intended to utilise the existing port for the fishing fleet and to extend the present mole and build a new one for the protection of wharves that will be constructed outside for shipping, whereby much greater facilities will be provided for berthing the Cross-channel steamers. At Havre a dry dock, 312 m. long, has been completed, and a wharf, 1000 m. long, is nearly finished, while at practically all the other ports extensive works are being undertaken, with a view of meeting the new conditions of maritime transport, and, at the same time, facilitating the development of the fishing industry, which has for some years past been declining.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

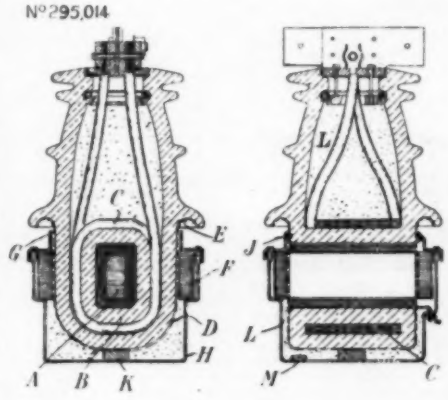
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

TRANSFORMERS AND CONVERTERS.

295,014. June 25th, 1928.—IMPROVEMENTS IN OR RELATING TO ELECTRICAL TRANSFORMERS, Koch und Sterzel A.G., of 40–42, Zwickauer Strasse, Dresden, Germany.

The transformer described in this specification is of the pot-type. The insulating body is made of china, and the bottom is closed. It encloses the middle leg A of a shell-type transformer, its secondary winding B and the primary winding C. The lower part of the insulating body is covered by a metal coating D, which is for the purpose of electro-static screening.

N° 295,014



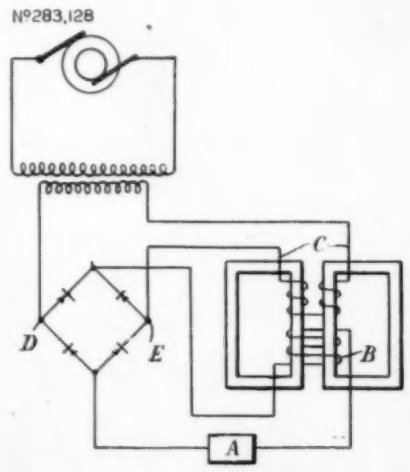
The metal coating extends to the point E on the groove on the underside of a collar. The external yoke F of the shell-type core is clamped between a flange G, encircling the china body and a shoulder in the wall of a metal container H, fixed to the flange G. Packing is provided at K, and the space within the container up to the packing ring J is filled with a mixture of sand and graphite L, which may be poured in through the hole M. The upper part of the body is also filled with a mixture of sand and graphite.—*October 18th*, 1928.

ELECTRICAL APPLIANCES.

283,128. July 26th, 1927.—RECTIFYING ALTERNATING CURRENTS, *The Westinghouse Brake and Saxby Signal Company, Ltd., of 82, York-road, King's Cross, London.*

A reactor device is utilised for regulating the voltage of the unidirectional current supplied by a rectifier of the metal compound type, the rectifier comprising rectifying elements

N° 283,128



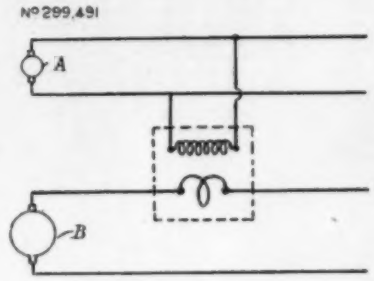
arranged bridge fashion, as shown. If during operation the load A increases, the increase in the current in the winding B decreases the impedance of the windings C, and a correspondingly larger voltage is impressed upon the terminals D and E of the rectifier. This increased voltage compensates for the increased voltage drop in the rectifier, which is due to the increase in the load current.—*October 26th*, 1928.

MEASURING AND TESTING INSTRUMENTS.

299,491. July 22nd, 1927.—WATTMETERS, Frank Wootton Highfield and the Highfield Electrical Company, Ltd., both of Faraday Works, Holbrooks-lane, Coventry.

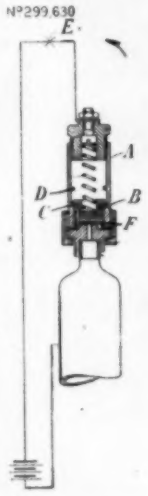
Hitherto wattmeters have been connected to a dynamo, which is driven by an engine, and the indications of the wattmeter have been used as a measure of the power developed by the engine. Difficulty has been experienced in obtaining accurate and convenient calibration of such instruments, owing to the variable efficiencies of the machines, from which the voltage and current coils of the instruments are supplied. In accordance with this invention, the voltage coil of the wattmeter or an additional compensating coil is supplied from a separate small dynamo A, the E.M.F. of which is proportional to the speed, whilst the current coil B of the instrument is driven by the engine or other prime mover under test. By separately exciting the voltage coil in the manner described, it has been found possible to improve the accuracy of wattmeters used for testing engines. The dynamo A may be connected to an electrical speed indicator

N° 299,491



as well as to the voltage coil of the wattmeter.—*October 22nd*, 1928.

N° 299,630



299,630. December 7th, 1927.—PRESSURE GAUGES, E. Menz and H. von Bruck, 37, Nestorstrasse, Berlin-Grunewald, Germany.

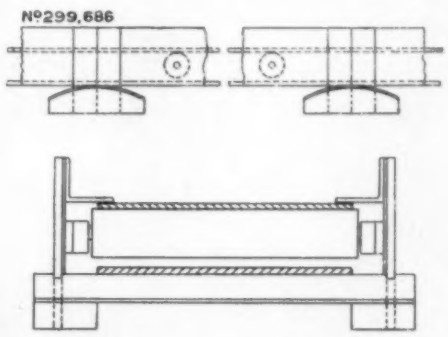
This gauge is intended for the indication of the gas pressure in CO_2 bottles. It comprises a cylinder A, attached to the head of the bottle, which contains a composite piston B. The part of this piston in contact with the wall of the cylinder is of electrical insulating material, while the cap above is of metal. The cylinder is provided with a shoulder C and a ring-shaped projection D, with either of which the metal part of the piston may make contact, and thus complete an electric circuit for the illumination of the signal lamp E. The outlet from the bottle is sealed by the rubber diaphragm F. At normal pressure the lamp is not lighted, but it indicates either excess or low pressure.—*November 1st*, 1928.

CRANES AND CONVEYORS.

299,686. July 1st, 1927.—COAL CONVEYORS, G. W. Bousfield and C. Davenport, Aztec Works, Neepsend, Sheffield.

This invention relates more especially to conveyors of the belt type for the transport of coal along the working faces in mines or in the gates or roads leading thereto. Such conveyors have to be readily and quickly dismantled and reassembled on a new site. The invention does not apply to conveyors which are permanent or semi-permanent fixtures, to portable elevators having fixed side frames or to scraper chain or plate or band conveyors. In shovelling material on to the belt of such conveyors in a confined space, it is difficult to avoid throwing some of it on to the return belt. This results in loading the latter, and, to prevent the material reaching the return or tension end

N° 299,686



pulley, brushes or ploughs have to be provided. To clear away the material brought off by the brush or plough requires frequently the whole time of one man. The inventors consequently provide a continuous shield which prevents material being thrown on the return belt, the space between the edges of the upper and the return belt being enclosed by a vertical plate. In order to secure these continuous side frames or shields together and to ensure perfect alignment, stools are provided having rectangular slots to receive corresponding supporting members which are attached to the extremities of the side frames. Since the side shields prevent the return belt becoming loaded, bottom rollers are unnecessary and support for the return belt is provided by the top surface of the stools being curved.—*November 11th*, 1928.

MACHINE TOOLS AND SHOP APPLIANCES.

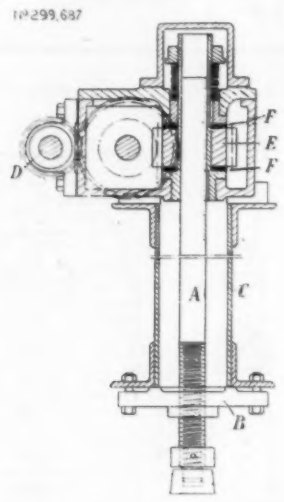
299,633. December 16th, 1927.—GRINDING STONES OR WHEELS, The Birmingham Small Arms Company, Ltd., and A. R. Page, Armoury-road, Small Heath, Birmingham, and P. S. Devereux, 24, Highgate, Tinsley, Sheffield.

This invention relates to improvements in grinding stones or wheels and refers more particularly to the kind in which a plurality of abrasive segments are mounted upon a metal drum, and held in place by clamping devices, and the spaces or interstices between the segments filled with cement or other material to bind the segments and fill up the interstices or spaces. It is found, according to the inventors, that when calcined magnesium oxide is mixed with a strong aqueous solution of magnesium chloride, the resultant paste sets to a hard mass in a few hours, forming a basic oxychloride of magnesium, and by mixing with this paste, before setting, a proportion of abrasive grit, when set a product is obtained which approximates to the form of grinding wheel material, but is slightly softer. As the result of experiments, it has been found that a good mixture comprises the following composition:—Magnesium cement, one part by weight; abrasive grit, two parts by weight. The composition of the cement itself may vary, and the following proportions have been found to give good results:—Calcined magnesium oxide, 60 grms.; saturated solution of magnesium chloride,

60 to 90 cc. In practice, the complete mixture would comprise the following rough proportions:—Abrasive grit, 100 parts by weight; magnesium oxide, 15 parts by weight; saturated solution of magnesium chloride, 35 parts by weight. The ingredients are mixed thoroughly into a paste which, while in a plastic state, is applied to the surfaces of the segments to be joined; the assembled parts constituting the complete grinding wheel are then left in a dry place, and without application of heat, the cement will set and securely bind together the several parts.—*November 1st*, 1928.

299,687. June 6th, 1928.—HOLDING-DOWN SCREWS FOR PLATE-EDGE PLANERS, Smith Brothers and Co. (Glasgow), Ltd., and A. Ferguson, 71, Park-street, Kinning Park, Glasgow.

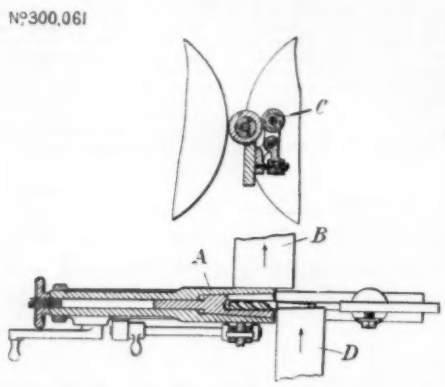
This device is intended for holding down the edges of plates in the process of planing. A series of screws A pass through nuts



B in a beam C, as is usual. All the screws are operated by the shaft D, which is driven by any convenient motor. The power is transmitted from this shaft to the worm wheel E on the screw through friction discs F F, which can be adjusted to provide any desired clamping force.—*November 1st*, 1928.

300,061. February 24th, 1928.—CENTRELESS GRINDING MACHINES, *V. A. B. Hughes*, 25, *Market-street, Manchester*.

This invention is concerned with an adjunct for centreless grinding machines, which enables them to be used for grinding concentric surfaces, such as the body and shank of a twist drill. The body of the drill is ground in the usual manner by passing

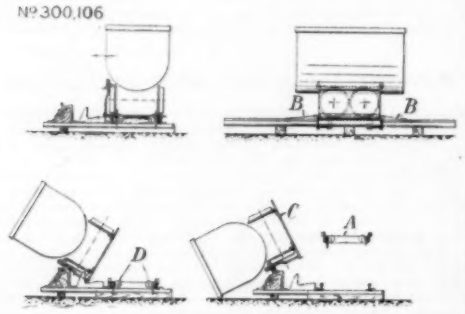


it straight through between the two wheels. It is then gripped in the collet chuck A, which is supported by a special holder bar and is pressed up against the regulating wheel B by the spring-roller C. The regulating wheel has the effect of rotating the chuck and work piece, while the grinding wheel D does the actual grinding.—*November 8th*, 1928.

TRAMWAYS AND RAILWAYS.

300,106. June 25th, 1928.—TIPPING WAGONS, Mines Domaniales de Potasse d'Alsace, Wittelsheim, Haut-Rhin, France.

The idea of this invention appears to be to allow a wagon to be tipped easily by one man without requiring a permanent interference in the continuity of the permanent way. The wagon is simple and needs no comment. At the point of tipping a frame A is placed over the rails and the wagon runs up on to it

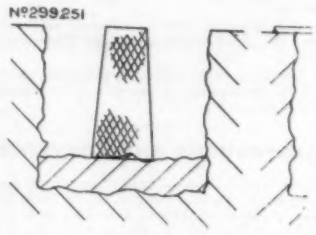


over ramps B B. On the top of this frame there is a loose carriage C, which can be moved transversely on the rollers D. The wagon is secured on the carriage by guards engaging the flanges of its wheels and is tipped as shown. It is explained in the specification that, should a wagon have been tipped and it is desired to continue normal traffic, it is only necessary to remove the frame A.—*November 8th*, 1928.

MISCELLANEOUS.

299,251. February 24th, 1928.—ANCHOR BOLT HOLES, W. C. Kennedy, Cononbank, Kinlochleven, Argyll.

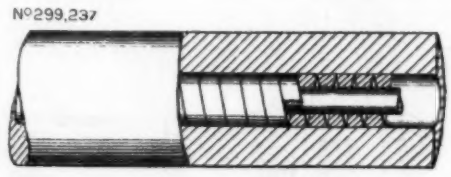
The inventor proposes to form the holes for anchor or holding-down bolts in concrete foundations by means of formers of



expanded metal, which are left in place. The expanded metal used is of such a mesh that the exterior concrete will not flow through the openings into the hole, but will merely protrude to form a rough interior surface.—*October 25th*, 1928.

299,237. January 20th, 1927.—MAKING HOLLOW METAL BARS, A. P. Pehrson, Attercliffe Wharf Works, Sheffield.

This invention is concerned with the rolling of hollow metal bars, such as drill steel. The place of the usual core is taken by a composite core, which, as shown in the illustration, comprises



a central portion and a helical surround. The cross section of the helix after the fashion of a keystone in order to ensure a continuous surface on the outside. The helix is preferably of copper and the centre may be of copper, steel or even sand if the ends of the billet are plugged. It is claimed that this core is easily withdrawn when the rolling is completed.—*October 25th*, 1928.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

TO-DAY.

CHEMICAL ENGINEERING GROUP.—In the Rooms of the Chemical Society, Burlington House, Piccadilly, W. 1. "The Air Lift as a Chemical Engineering Appliance," by Mr. Norman Swindin. 8 p.m.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH, BURNLEY SECTION.—Municipal College, Ormerod-road, Burnley. "Comparison of English and French Moulding," by Mr. S. Stanworth. 7.15 p.m.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—In the Non-ferrous Section of the Applied Science Department of the University, St. George's-square. "Chromium Plating," by Mr. L. Wright. 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, S.W. 1. General meeting. "Cutting Tools Research Committee Report on Machinability," by Mr. E. G. Herbert. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. "Locomotive Boiler Washing Plant," by Mr. E. J. M. South. 7.30 p.m.

KEIGHLEY ASSOCIATION OF ENGINEERS.—Room 14, Temperance Institute, Keighley. "Conveying," by Mr. J. N. Lee. 7.30 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS.—At the Engineers' Club, 17, Albert square, Manchester. Lecture illustrated by lantern slides, "The Dismantling, Transportation and Erection of Heavy Machinery," by Mr. Norman E. Box. 7.15 p.m.

PHYSICAL SOCIETY.—Imperial College of Science, Imperial Institute-road, South Kensington, S.W. 7. "A Survey of Heat Conduction Problems," by Dr. Ezer Griffiths, F.R.S. 4.45 p.m. Editing Committee Meeting, 3.30 p.m.; Council Meeting, 4 p.m.

POLYTECHNIC ENGINEERING SOCIETY.—Fyrie Hall, The Polytechnic, Regent-street, London, W. 1. Annual conversazione. 7.30 p.m.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE.—"Societies' Room," No. 24, Royal Technical College, George-street, Glasgow. Paper on "The Position and Prospects of the Steel Industry," by Professor W. R. Scott. 7 p.m. The Council will meet at 6.30 p.m. in Committee Room No. 26.

SATURDAY, DECEMBER 15TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH, JUNIOR SECTION.—College of Technology, Sackville-street, Manchester. "The Application of the Microscope to the Study of Metals and Alloys," by Mr. G. Mohn. 7 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Students' visit to the Weybridge works of Vickers (Aviation), Ltd.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS.—Lecture Theatre of the Institute, Newcastle upon-Tyne. Discussions on "Extracts and Recommendations from the Report of the Water Dangers Committee," by Mr. T. Greenland Davies; "Notes on the Conversion of Main Pumping from Steam to Electricity, with Special Reference to the Plant Installed at Messrs. The Stella Coal Company's Clara Vale Pit," by Mr. L. H. Forster. The following paper will be read:—"Roof Control on Longwall Faces," by Mr. John F. C. Friend. A patent drag for pit tubs will be exhibited and described by Mr. M. Jordan. 2.30 p.m.

MONDAY, DECEMBER 17TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Royal Technical College, Glasgow. "Recent Developments in the Study of the Fatigue of Materials," by Dr. H. J. Gough. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—The College, Loughborough. Graduates. "Servo-Equipment," by Mr. C. K. Spied. 7 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Bolbec Hall, Newcastle-on-Tyne. Informal meeting in the Institution Library. Subject for discussion, "Could the Method of Conducting Measured-mile Trials be Improved?" To be introduced by Mr. John Neill. 7.15 p.m.

RAILWAY CLUB.—57, Fetter-lane, London, E.C. 4. "Recent Developments in Main Line Electrification in France," by Mr. J. Pelham-Maitland. 7.30 p.m.

TUESDAY, DECEMBER 18TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Broadgate Café, Coventry. "Automobile Brakes," by Mr. L. H. Dawtrey. 7.15 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Engineering and Scientific Club, Queen-street, Wolverhampton. "Modern Problems of Engine Lubrication," by Mr. L. H. Pomeroy. 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, London, S.W. 1. "The Reconstruction of the New Holland Pier," by Mr. J. H. Nicholson. 6 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. Lecture on "The Work of the Late Sir Joseph Swan," by Mr. J. Swinburne, F.R.S. 5 p.m. The following paper will subsequently be read and discussed:—"An Introduction to Researches on Circuit Breaking" (Electrical Research Association Report), by Mr. E. B. Wedmore (Member) Dr. W. B. Whitney, and Mr. C. E. R. Bruce.

WEDNESDAY, DECEMBER 19TH.

CRYSTAL PALACE SCHOOL OF PRACTICAL ENGINEERING.—One hundred and sixty-eighth award of certificates. 3 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Queen's Hotel, Birmingham. Graduates. "Two-stroke Engines," by Mr. W. G. Copestake. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Engineers' Club, Albert-square, Manchester. "The Design of a Town Carriage," by Mr. J. O. H. Norris; "Suggestions relating to the Design of Automobiles," by Mr. F. H. Paul. 7 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, London, S.W. 1. Students' meeting. "The Harbour Improvement Scheme at St. Peter Port, Guernsey," by Mr. I. W. G. Freeman. 6.30 p.m.

INSTITUTION OF CIVIL ENGINEERS: MANCHESTER AND DISTRICT ASSOCIATION.—At 36, George-street, Manchester. "Notes on the Purification and Disposal of Sewage," by Mr. V. G. Pickering. 6.45 p.m.

NEWCOMEN SOCIETY.—Prince Henry's Room, 17, Fleet-street, E.C. 1. "Prehistoric Agriculture in Britain," by Mr. E. Cecil Curwen. To be followed if time serves by "Notes on French Windmills," by Mr. H. O. Clark. 5.30 p.m.

OVERHEAD LINES ASSOCIATION.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2. "Insulators," by Mr. C. W. Marshall. 5.30 p.m.

RAILWAY CLUB.—Manchester Hotel, Aldersgate-street, E.C. 1. Twenty-second annual dinner. 7.30 p.m.

ROYAL METEOROLOGICAL SOCIETY.—49, Cromwell-road, South Kensington, London, S.W. "The Dines Float Barograph," by Mr. L. H. G. Dines; "The Distribution of the Average Seasonal Rainfall Over Europe," by Dr. J. Glasspoole. 5 p.m.

FRIDAY, DECEMBER 21ST.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Informal meeting. "Oils for Cutting and Quenching Purposes," by Mr. C. H. Hudson. 7.30 p.m.

FRIDAY, JANUARY 11TH, 1929.

MANCHESTER ASSOCIATION OF ENGINEERS.—Midland Hotel, Manchester. Annual Dinner. 6.45 p.m.

CONTRACTS.

BELLISS AND MORCOM, Ltd., of Birmingham, have received an order for eight 100 kW Diesel driven auxiliary generating sets for two vessels now being built by Scott's Shipbuilding and Engineering Company, Ltd., for Messrs. Alfred Holt and Co.

RICHARD GARRETT AND SONS, Ltd., of Leiston and Aldwych House, Aldwych, London, W.C. 2, have received from Samuel Instone and Co., Ltd., of 52, Leadenhall-street, London, E.C., a provisional order for one hundred of their rigid six-wheeled undertype steam wagons.

A.C.E.C. (Ateliers de Constructions Electriques de Charleroi), the London office of which is at 56, Victoria-street, London, S.W. 1, have received from the Union des Centrales Electriques du Hainaut an order for the manufacture, laying and jointing of 88 miles of 30,000-volt "H" type armoured cable.

THE CEMENT MARKETING COMPANY, Ltd., has received an order for 6000 tons of "Ferrocrete" for the construction of a concrete hangar at Seville. The building is to house two super Zeppelins which are to be used in connection with the new Spanish air service to operate between Seville and Buenos Aires.

THE EAGLE ENGINEERING EXPORT COMPANY, of Warwick, and 45, Pall Mall, London, S.W. 1, has received orders for eighty pneumatic-tired four-wheel trailers for the Indian Government; for twenty-six solid rubber-tired two-wheel 5-ton trailers for a roadmaking contractor; and for eighteen solid rubber-tired four-wheel 10-ton trailers for Egypt.

THE GREAT WESTERN RAILWAY COMPANY officially announces that the following contracts have been placed:—(*a*) Electric drilling plant for "V" Shop, Locomotive Works, Swindon: Messrs. Constructions Electriques Wageor, 19, Rue Turgo, Paris; (*b*) quasi-arc portable welding set for Swindon Locomotive Works: the Quasi Arc Company, Ltd., 15, Grosvenor-gardens, Victoria, London, S.W.; (*c*) two electrically driven vertical ram pumps for Southall: Tangyes Ltd., Cornwall Works, Birmingham; (*d*) combined turret head boring and turning mill for "R" Shop, Locomotive Works, Swindon: Martin Bros. (Machinery), Ltd., Empress Works, Empress-street, Cornbrook, Manchester; (*e*) carrying out repairs for the overhaul of steam hopper barge No. 3: Thos. Diamond and Co., Ltd., Bute Docks, Cardiff; (*f*) work in connection with the renewal of Board of Trade passenger certificate of steam tender "Smeaton": Bickle Engineering Company, Great Western Docks, Plymouth; (*g*) construction of goods shed at Morris Cowley Station: H. and C. Spackman, Hunt-street, Victoria-road, Swindon; (*h*) fifty-two forward-control 30-cwt. goods chassis with Henley air cushion tires: John I. Thornycroft and Co., Ltd., Thornycroft House, Smith-square, S.W. 1; (*i*) four rigid six-wheel steam wagons: Fodens, Ltd., Elworth Works, Sandbach; (*j*) thirty-five four-cylinder, 32-seater M.L. 3 low level safety passenger chassis: Maudslay Motor Company, Ltd., Parkside, Coventry; and (*k*) one four-cylinder, 20 horse-power "Carlton" saloon car, one 16 horse-power "Open-road" touring car, three 16 horse-power "Burnham" saloon cars: Austin Motor Company, Ltd., 479, Oxford-street, W. 1.